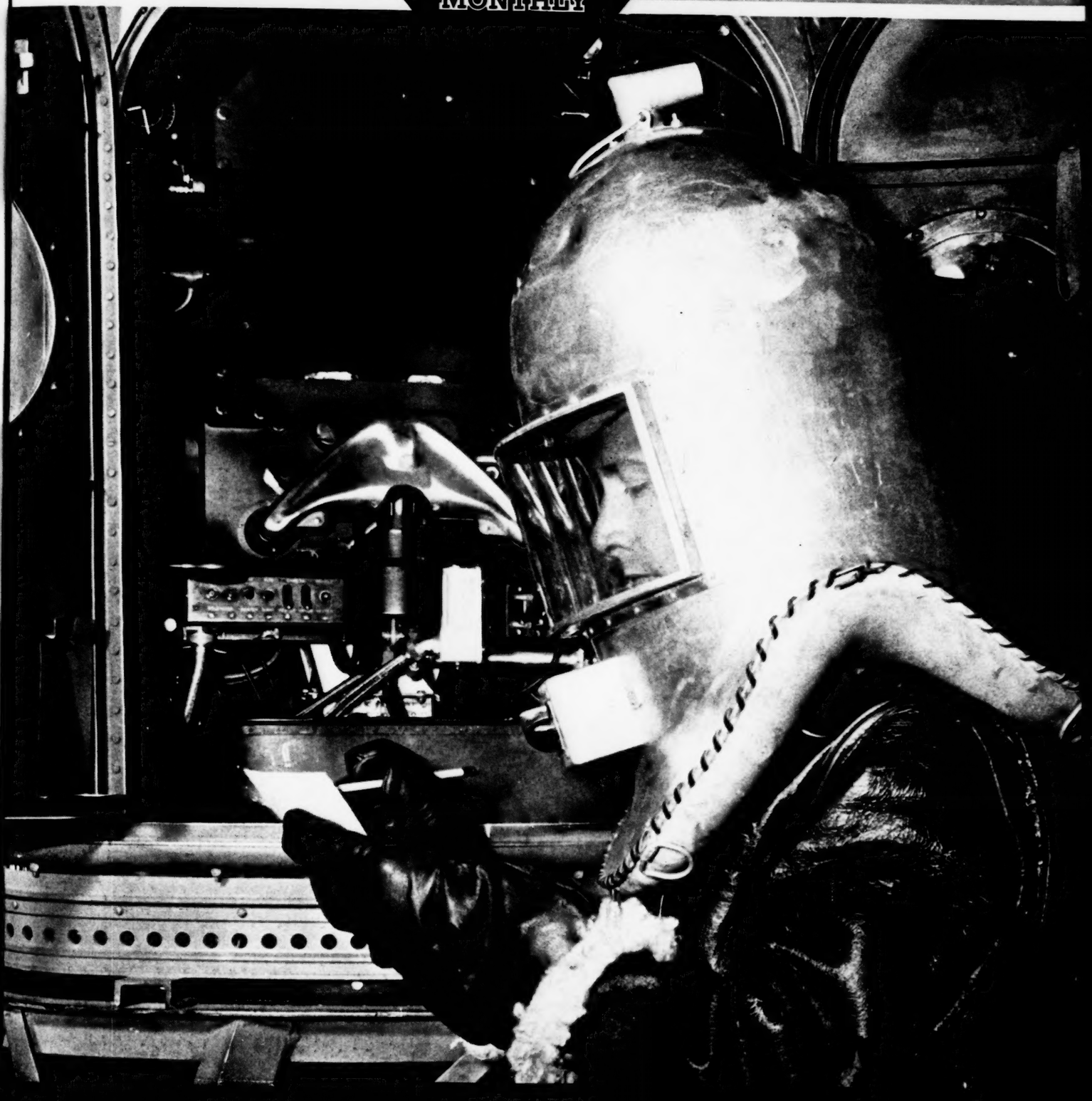
OCT 28 1943

HEATING AND VENTILATING

THE AIR CONDITIONING MONTHLY



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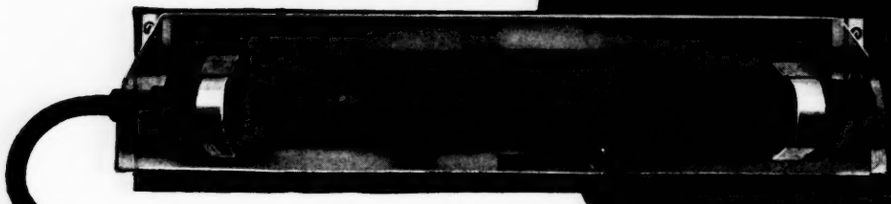

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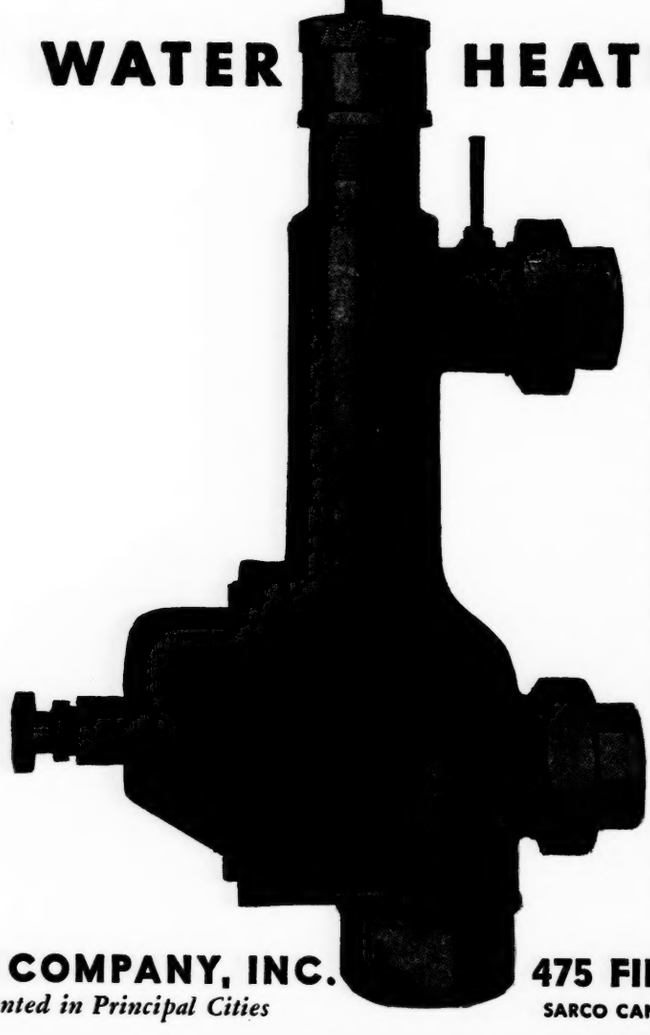

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VOLUME 40, No. 10

HEATING AND VENTILATING

The Air Conditioning Monthly

FOR

Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning.

THIS MONTH'S COVER

A view of the windowless plant of the Douglas Aircraft Company in Oklahoma City, Oklahoma, recently completed by The Austin Company

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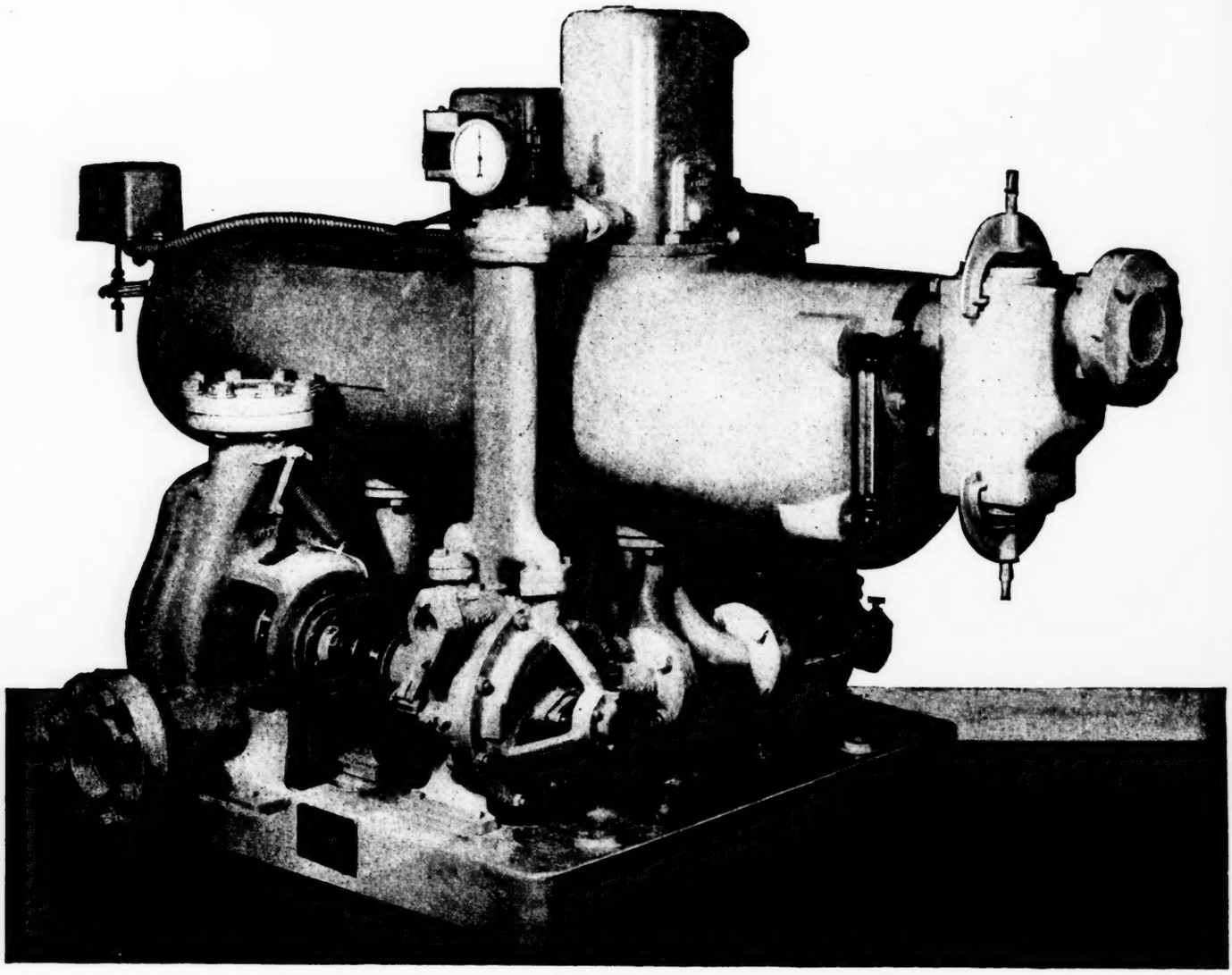

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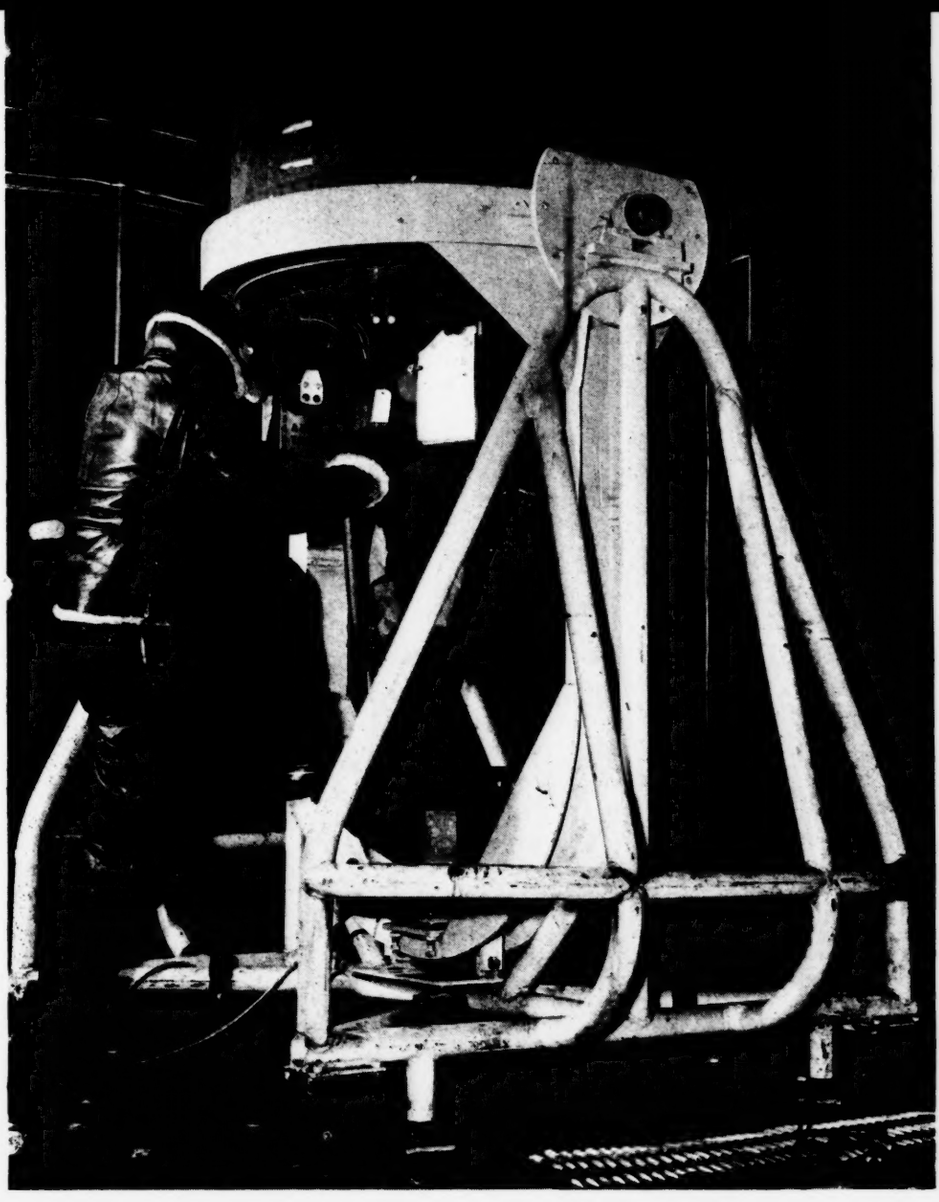


Fig. 1. Upper turret set up in jig, and gunner preparing to fire test at 60 degrees below zero.

AIR CONDITIONED FIRING RANGE

for testing bomber gun turrets is maintained at —60F. Design and operating problems are here described by Louis W. Greenblatt, experimental engineer, The Emerson Electric Manufacturing Co.

MODERN aerial bombardment has undergone many fundamental changes which are manifested in many ways including the defensive armament protecting our expensive and intricate airplanes of today. When one considers that every large bombardment airplane represents the investment of several hundred thousands of dollars for the airplane alone, and each member of the crew an additional five to thirty thousand dollars depending on circumstances and the function of the individual, it is readily understandable that much emphasis has now been placed on the development of adequate defensive armament.

Prior to the advent of our modern high altitude long range bombers as well as various types of fast fighter and torpedo carrying airplanes, guns were

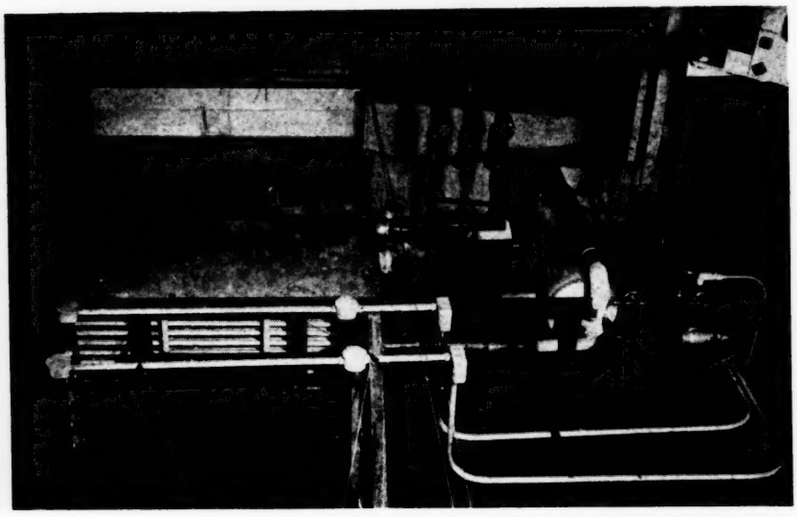


Fig. 2. Installation of two of the coils, valves, etc. Note strip heaters beneath coils.

generally manually maneuvered and aimed. However, as the strength and stamina of man is substantially decreased at high altitudes, and in addition, the air speeds of modern military airplanes have substantially increased (with resultant increased wind loads on the protruding portions of the gun barrels) the force required to manipulate the guns increased to a point where it became impossible to manually maneuver guns rapidly enough or to hold a steady aim. Moreover, the size of armament has steadily increased from a single .30 caliber machine gun used almost entirely up until three or four years ago, to multiple installations of larger caliber guns. This increase has naturally carried with it tremendously larger recoils which make it very difficult to maintain steady aim.

These factors, along with many others such as the necessity of increased fire power, requirements for larger ammunition allowances, and the introduction of new types of gun sights, have been the fundamental reasons motivating the development of the present power-operated aircraft gun turrets. There are many considerations which enter into the design and development of a functionally suitable and tactically successful turret, with perhaps two of the most difficult and important problems arising from stratosphere conditions of low temperatures and rarified atmosphere.

Although the various component parts can be tested in a small stratosphere chamber, wherein the density, temperature, and humidity are controlled, it is still necessary to test the completed turret at low temperature. Such sub-assemblies as solenoids, relays, electric motors, switches, electrical collector or slip rings, hydraulic equipment, etc., are tested as individual units in the stratosphere chamber and checked for low density and low temperature operation. For these tests the stratosphere chamber shown in Figs. 4 and 7 is used.

However, inasmuch as these assemblies when integrated into the final turret all have a direct bearing or relationship on the functioning of the basic armament installation, it was necessary that a cold room be designed that not only would accommodate a complete turret, but would permit firing the turret under the low temperature conditions with service guns and regulation combat ammunition.

The cold room in The Emerson Electric Mfg. Co. plant was designed to accommodate two turrets at one time and is approximately 17½ ft wide, 18 ft long, and 26 ft high. As may be seen in Fig. 3, there are two doors approximately 4 ft by 4 ft in the front wall of the cold room which open up on the range through which the guns are fired. When firing turrets during low temperature tests a heavy canvas is placed over the opening and just prior to firing the doors are opened. Firing is done through this canvas which is placed over the opening to prevent warm air from entering the room, thus causing an excessive temperature rise and subsequent frosting

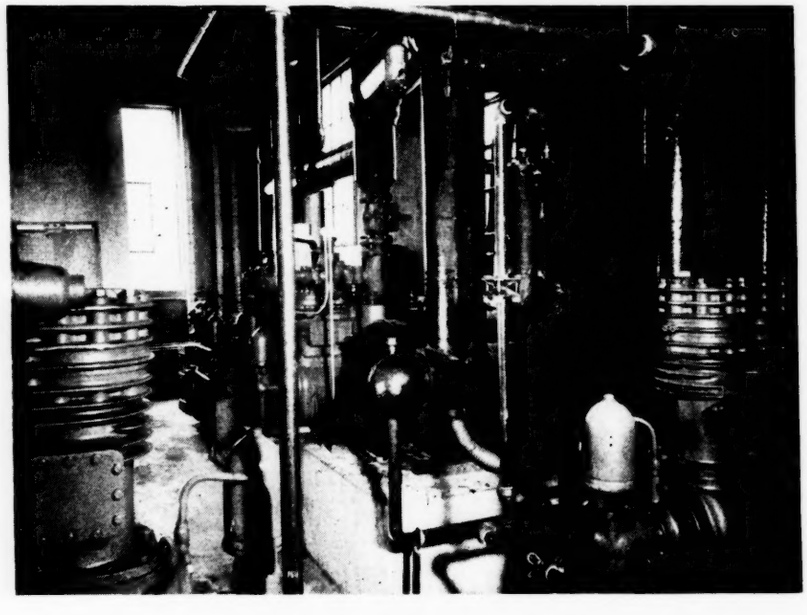


Fig. 3. Compressor installation. Two compressors in foreground comprise the second stage and the two compressors in the background are the first stage.

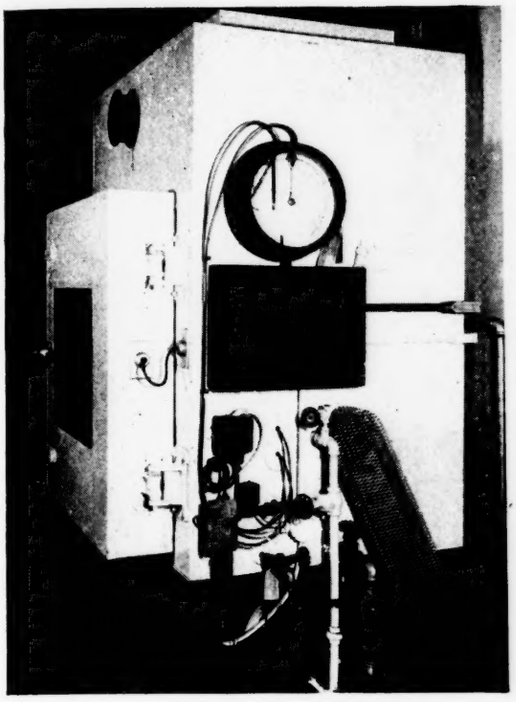


Fig. 4 (Left). Side view of stratosphere chamber showing controls, and temperature and relative humidity recorder.

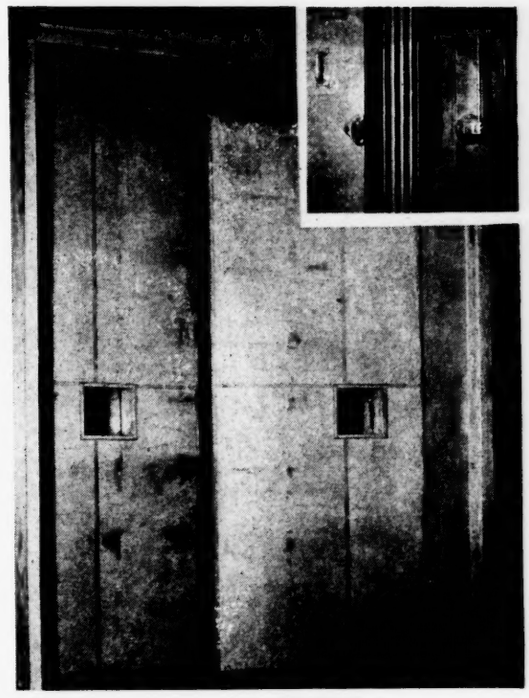


Fig. 5 (Right) Main doors with observation ports, through which turrets are moved in and out of the cold room as viewed from the inside. Inset shows multiple weather - stripping employed on all doors.

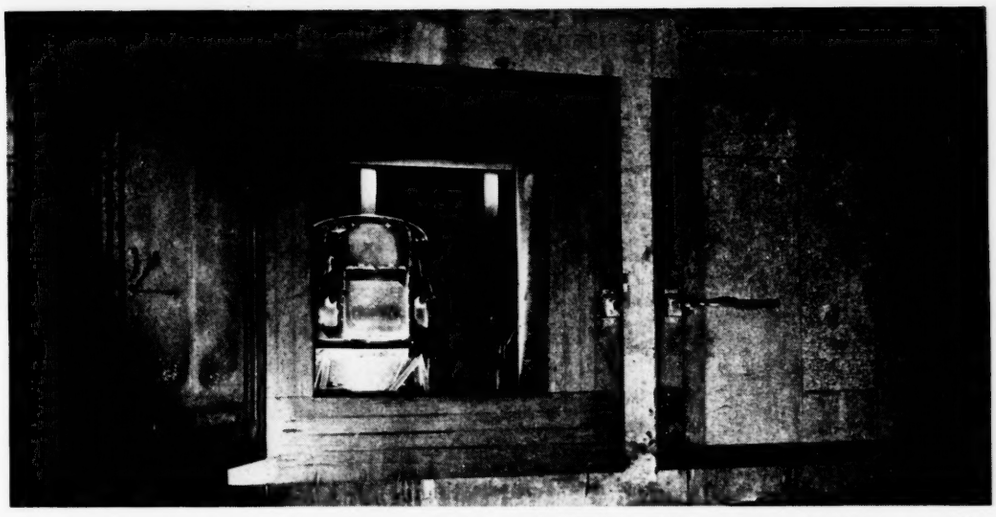


Fig. 6. Gun firing ports showing turret set up for firing. The canvas which is normally installed on inside of the door, and through which the guns are fired, has been removed to show the turret set-up. Note observation window on far wall.

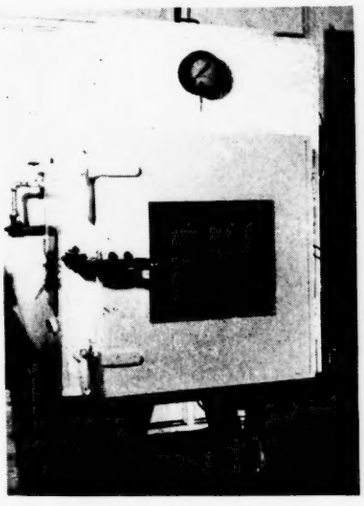
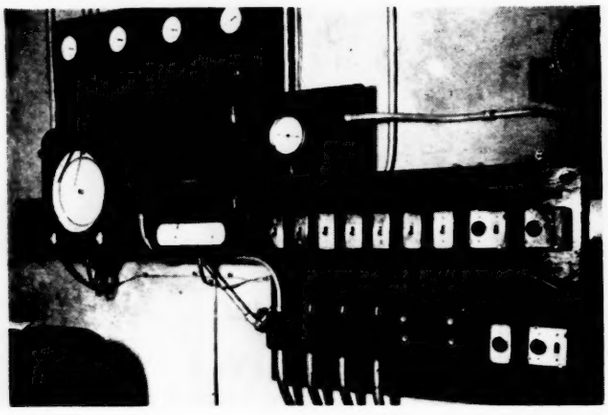


Fig. 7 (Left). Front view of stratosphere chamber. Note altitude gauge above door and terminals for instrumentation leads at extreme left. Fig. 8 (Center). Outer door of vestibule. Fig. 9 (Right). Interior of vestibule for entrance and exit of test personnel. Note small cold air duct opening on rear wall.



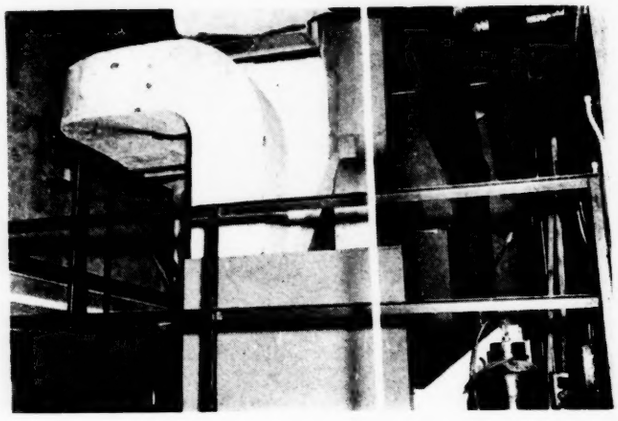


Fig. 10 (Left). Main control panel. Fig. 11 (Right). Installation of duct work, dehydration equipment, and drying ovens.

of the refrigeration coils. The canvas was removed when Fig. 6 was taken to show the position of a turret during low temperature firing tests.

Fig. 1 shows a turret set up for firing and bolted to one of the two cast iron bed plates which are approximately 4 ft wide by 6 ft long by 6 in. thick, and cast into the concrete floor. These plates have tee slots milled in them and must be anchored substantially enough to withstand the trunnion reactions of the largest armament to be tested. The trunnion reactions under these conditions may be as high as six or eight thousand pounds acting on a moment arm of seven or eight feet. Thus a torque tending to lift the front (or back in the case of counter recoil) of the bed plate out of the concrete floor is many times the trunnion reactions.

Clothing used by the test engineers during the cold tests are the standard winter flying suits which are leather suits lined with sheepskin. During short periods of exposure practically no discomfort is encountered except that after thirty or forty minutes in the cold room at —60F, the moisture from one's breath causes frosting on the eyelashes and eyebrows. When tests require the engineers to remain in the cold room for three or four hours, a helmet is worn to prevent frosting of the eyebrows and eyelashes, as well as frozen faces. With these helmets it is not at all difficult to remain at —60F indefinitely.[1] The cold room has walls approximately 12 in. thick, and the walls and ceiling have 12 in. of cork insulation. The entire floor of the cold room is unsupported to provide a dead air space beneath the floor for insulation purposes due to the fact that it was impossible to install cork insulation on the floor because of the turrets mounted in their heavy firing jigs or fixtures. The only insulation on the concrete floor is a hard wood covering which in addition to providing some insulation, prevents frosting of the concrete, and facilitates moving the equipment in and out, as well as the anchorage of miscellaneous test equipment installed temporarily for the various tests.

In addition to the two firing port doors, there is a pair of large doors (Fig. 5) approximately 5½ ft wide by 13 ft high by 13 in. thick for moving the turrets in and out, and a vestibule or chamber (Figs. 8 and 9) for test personnel when going in and out of the room during tests.

Through all of the walls, except the front one, there are transite conduits 2 in. in diameter for instrumentation leads when running tests on vibration analysis, stress analysis, etc., using such delicate instruments as electric recording strain gages, vibration pickups, etc., recording on an oscillograph located outside, which, of course, cannot be subjected to the extremely low temperatures inside the cold room. There is also a loud speaker and microphone both inside and outside the cold room for intercommunication.

In the rear wall, and in each of the large doors, are observation windows which are constructed of seven layers of glass with silica-gel as a dehydrating agent between each of the layers. Proper design of observation windows was of the utmost importance as practically all tests require a great deal of coordination between test personnel in and out of the cold room, because of all the instrumentation necessary on the tests, and also for obvious safety precautions.

Before the installation of the cold room was completed, it became necessary to run certain tests, which was most fortunate, as it was found necessary to face all of the exposed cork on the walls and ceiling with some material which would prevent the cork from flaking or spalling as a result of the gun blasts. After several materials were tried, it was found that an asphalt covering was most suitable. This completely solved the problem; however, it would have been extremely difficult and expensive to do this if the condition had not been found until after the coils, strip heaters and valves were installed.

The Carrier Corporation handled the job using their own compressors, Powers regulation control, and Bryant dehydration equipment. The refrigeration system employs Freon 12, and is a cascaded system of two stages, the first stage consisting of a 40 hp and 60 hp compressor, turning 440 and 660 rpm respectively, and the second stage employing

[1]See illustration on front cover showing one of these helmets.

two 15 hp compressors, both turning at 660 rpm. The first stage pulls a vacuum of approximately sixteen to seventeen inches of mercury on the low side, and the pressure on the high side is from fifty to one hundred twenty pounds; while the second stage pulls a vacuum of twenty-five to twenty-seven inches of mercury.

The 60 hp compressor has a cylinder cutout incorporated in it to cycle two of the four cylinders thereby reducing the efficiency to approximately 50%. This gives the maximum flexibility, as all of the equipment is operated from manual controls, thus permitting the use of one-half of the 60 hp compressor or 30 hp, the 40 hp compressor, 60 hp compressor, a 40 and half of the 60 hp compressor totalling 70 hp, or the 40 and 60 hp compressor totalling 100 hp for the first stage of refrigeration. The second stage can, of course, employ one or both of the 15 hp compressors. All compressors have oil separators and the first and second stages both have oil equalizers and oil level lines tying both the compressors of the first stage together and both the compressors of the second stage together.

The system is a flooded system employing float valves rather than the usual type system using expansion valves. The refrigerant temperature averages about —72F for a room temperature of —60F. A full charge of refrigerant in the system is approximately 3000 lbs. Fig. 2 shows the installation of two of the coils and their float valves and strip heaters. The other two coils are mounted on one of the adjacent walls in a like manner.

The condenser installed on the roof of the firing range is of the evaporative type, having a fan turning 1100 rpm, handling 9000 cfm of air, and powered by a 3 hp motor. There is a single circuit coil of approximately sixteen square feet of free air area, including the sub-cooling coil. This sub-cooling coil further cools the refrigerant after it has been liquified. All the coils in the condenser are sprayed with water, treated and fed by means of a small pump. On the basis of the original calculations, this condensing equipment saves approximately 100 gpm of water over the conventional shell and tube type condenser.

Oil capacity of the compressors is in the neighborhood of thirty-six gallons of oil, there being about seven and one-half gallons for a full charge in each compressor, the remainder being in the system. A low temperature oil having a pour point of —35F is used, which with the Freon is good for about —150F.

As originally planned, the design was to have two coils of twelve rows each of approximately twelve square feet of area. However, after preliminary tests it was found that due to the atmospheric conditions around St. Louis during the summer, with temperatures in the high nineties, and relative humidities of 80-85% or even 90% not at all uncommon, it would be necessary to increase the coil area to approximately 27½ square feet. The four coils have installed beneath them eighteen 1000 watt strip heaters, and eighteen 1250 watt strip heaters, making a total of 40,500 watts of strip heaters for defrosting the coils during long tests. It is also possible to raise the temperature of the room during the course of any test by means of these strip heaters which are controlled from a bank of switches to provide the maximum number of combinations of strip heater wattage.

The 40 hp compressor in the first stage can be isolated from the rest of the system for use in the dehydrating system supplying fresh air. This is an economical means of operating during the initial re-

Fig. 12 (Left). Recording of temperature during dehydration and pull-down period. Fig. 13 (Right). Recording of temperature during test.

frigeration period prior to the dehydrating of the room. The pull down at 10:20 a.m. on Fig. 12 from 64F to 0F was accomplished with this compressor alone. Approximately 800 cfm of fresh air and 14,000 cfm of recirculated air can be handled.

In addition to the requirement of having comparatively rapid temperature changes possible, the large quantity of air handled was necessitated by the gun gases which are given off in large volume especially when two or four guns are fired.

The dehydration equipment, shown in Fig. 11, necessary for these climatic conditions, as well as the type of testing to be done, consisted of two large drums 32 and 50 in. in diameter. The drums rotate one revolution each seven and one-half to eight minutes, with half of the drum being in the drying oven reactivating the silica-gel, and the other half in the fresh air intake duct. The ovens are thermostatically controlled, at about 300F which reactivates the 54 lb of silica-gel in the small drum and 83 lb in the large drum. The moisture content of the air in the cold room is generally in the neighborhood of two grains of moisture at the start of the temperature pull down in order to reduce to a minimum defrosting operations. Each defrosting cycle will, of course, raise the temperature of the room slightly, and depending on the frequency of this operation, the time varies between five and fifteen minutes until the temperature at the beginning of the defrosting period is again reached.

Figs. 12 and 13 are two typical charts, chart 12 showing the initial pull down to 0F, and the subsequent dehydrating period of nine hours, and the final pull down to —55F. Chart 13 shows the remainder of the pull down and the maintenance of —60F for approximately thirteen hours. As may be noted on chart 12, the first stage of refrigeration was in operation between 8:45 a.m. and 10:20 a.m. At 10:20 the second stage of refrigeration was placed in operation, which explains the sharp drop in temperature from +2F to approximately —55F. At approximately 3:35 p.m. three test engineers entered the cold room and started the turret, which accounts for the temperature rise to approximately —55F as a result of the occupancy load and the heat given off by the drive motors of the turret. At about 4:25 p.m., one firing port door was opened (without the canvas) to determine the effect of opening the doors. Upon closing, the temperature was again brought down to —52F and the doors again opened. After closing the doors at 4:45 p.m. the temperature was once more brought down, but the coils were frosted up a little as a result of opening the door, allowing the warm wet air to enter the room, thus the temperature did not come all the way down to —60F.

The above test was made primarily to verify the fact that the canvas cover over the gun port door would be necessary as originally planned.

In keeping with the program of conservation of strategic materials, the entire system employed no copper tubing, welded steel pipe being used throughout with the exception of a very few fittings.

The erection of the Turret Plant was supervised by The Austin Company, engineers and builders.

Complete Air Conditioning System Moved 175 Miles

How resourcefulness and ingenuity were applied to permit a carpet mill to switch over quickly to the manufacture of cotton duck for the government was told recently by officials of the Magee Carpet Company, Bloomsburg, Pa. The story is one of cooperation between the company and air conditioning engineers in breaking what appeared to be an almost insuperable bottleneck.

Before the war, the Magee Carpet Company worked primarily with wool. When war came, their looms were set up to make cotton duck for the Army, but difficulties were encountered with weather changes because the weave room was not equipped with humidity control. The weaving of cotton called for high humidity air and constant humidity control. It appeared that the required humidifying equipment would not be available under wartime restrictions, but the operating difficulties demanded an immediate solution to the problem.

Engineers of the Power Engineering Corporation, Wilkes-Barre, Pa., learned of a silk mill in Philadelphia which contained Carrier humidifying equipment and which had been closed when silk became scarce. A check-up revealed that this central station equipment would meet the requirements of the Magee space.

Negotiations with the Philadelphia silk mill were quickly completed and dismantling began. As equipment was removed from the abandoned mill, each piece of ductwork, apparatus casing and connections, dampers, outlets, structural steel and all other parts were carefully marked so that re-assembly would be simplified as much as possible. All parts of the complete equipment and accessories were salvaged, including structural steel supports, switches and controls, steam and water piping.

A total of over 35,000 lb of equipment was loaded on trucks, often in pieces so large that the trucks had to take roundabout routes in order to miss low bridges. Upon arrival at Bloomsburg, about 175 miles from Philadelphia, the equipment was cleaned and painted, all dents and rough edges removed, and all accessories checked and placed in first-class operating condition. Then reconstruction began.

Today, the Magee Carpet Company is weaving duck for the Army and the reclaimed Carrier equipment is serving as well as if it had been designed originally for the Magee operation. The system is maintaining a constant relative humidity of 70%, which assures uniform production. Idle equipment has been put to work, critical materials salvaged, and a first-class installation obtained.

Central Air Conditioning vs. Unit System Under War Conditions

By T. W. REYNOLDS

AIR conditioned wartime plants are divided between those with large central air conditioning systems and those with unit systems. A central plant using centrifugal compressors and cooling water has some very definite advantages over a unit system, but it also has limitations, many of which are inherent to very large buildings and others of which are the result of compromises due to war restrictions. A comparison based on wartime conditions follows:

We know from experience with central systems with large and long water mains, large fans, washers and other equipment, that the erection is necessarily slow and that all parts are large items requiring long deliveries, whereas the unit system parts are more readily available from several manufacturers and can be installed much faster than can a central system. The reasons for this are that a considerable number of like installations can be installed as the building progresses with smaller pipe, fans, casings, etc., and with much of the pipe prefabricated. Since the work goes on progressively, manpower is also conserved as only a small crew of mechanics is required.

Evaporative condensers of unit systems which are cleaned from the outside are readily adaptable to steel, and leading manufacturers have always recommended steel even when copper was cheap and readily obtainable. On the other hand, experience has proven that steel should not be substituted for copper condensers in central systems as otherwise frequent cleaning will be required and efficiency will be reduced.

Water cooling systems require a heat transfer to cold water which always decreases efficiency, and centrifugal compressors require a cooling tower which in turn requires another transfer and increase in operating costs. Unit systems eliminate a transfer to cold water, and those with evaporative condensers need no cooling tower.

Centrifugal compressors require large water coolers. Recently steel has been substituted for copper tubes, but it is questionable if tubes of steel can be kept free of fouling even with water treatment. This is important considering that insulation on the water cooler must be broken and removed each time the tubes are cleaned. If all this is avoided by the use of air washers without water coils the system becomes open and will give most all of the disadvantages of the steel condenser tubes. In a direct expansion unit system air is cooled directly without the use of an intermediate transfer such as water coolers.

A unit system provides individual control in each area as well as a means of cooling and dehumidifying in some areas and simultaneously heating in others; furthermore, if only one area requires a dew point lower than the average area, then only one unit system is penalized. As compared to this operation, all of the water in a central system must be cooled to a temperature sufficiently low to satisfy the lowest dew point of the plant. Unnecessarily low temperatures for other parts of the plant are a waste of power.

To elaborate further upon this point, it is a fact that any refrigeration system varies in its ability to remove heat, depending upon the temperature at which the heat is discharged. In other words, if the water in a central plant removes the heat at 40F in order to satisfy the lowest dew point in the plant, the suction temperature of the central plant compressor becomes fixed by the lowest dew point temperature of the entire plant.

Compared to this situation, in a unit system the dew point temperature required due to an increase of motors in a local area may be very much higher than the lowest dew point in the plant, but the unit system will increase any tonnage because of the increased suction temperature which is possible in the area where this increased tonnage is required.

This advantage is impossible in a central system where, as mentioned, the water temperature fixes the suction temperature* of the central compressor, and this is one of the main reasons why it is possible to secure a considerably greater amount of heat removal from a unit system than from the central system, a fact especially true since this increased heat removal becomes available at the time it is most needed.

Before passing on, however, it should be noted that a unit system is at a disadvantage if the compressor selection is so made that direct expansion coils of considerable depth are required to remove the latent heat because of high refrigerant temperature due to high suction temperature.

(Concluded on page 96)

*Though it is true that the suction temperature is fixed, the central plant does have the ability of shifting capacity to meet varying loads throughout a building by varying the water flow through the different systems.

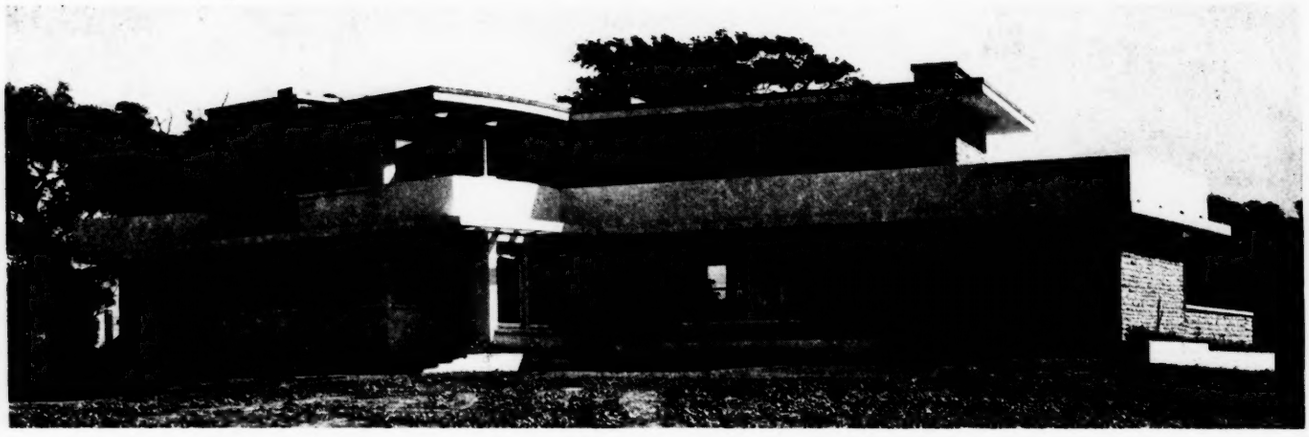


Fig. 1. H. F. Stimm residence, Williamsville, N. Y., designed by Sebastion J. Taureillo, architect, Buffalo, N. Y. Radiant heating system designed by Raymond Viner Hall, architect, Port Allegany, Pa.

Weather-Controlled Residential Radiant Heating System

By PAUL E. FREDERICK
District Engineer,
Iron Fireman Mfg. Co., Cleveland.

A RADIANT heating system automatically controlled to operate with fluctuations in outside temperature and with variations in indoor conditions is a feature of the modern residence recently built by H. F. Stimm at Williamsville, N. Y.

From an architectural viewpoint, the house shown in Fig. 1 includes many materials which were considered native to the vicinity, such as local limestone, cinder blocks and white wood trim. All windows and doors were glazed with double glass panels of Thermopane and the walls of the bath rooms, library, stair hall and dressing rooms were liberally treated with glass block construction to obtain additional daylight penetration.

Installation of Heating Coils

Poured concrete in pan type construction was used for the floor of the residence, with 4 in. wide concrete

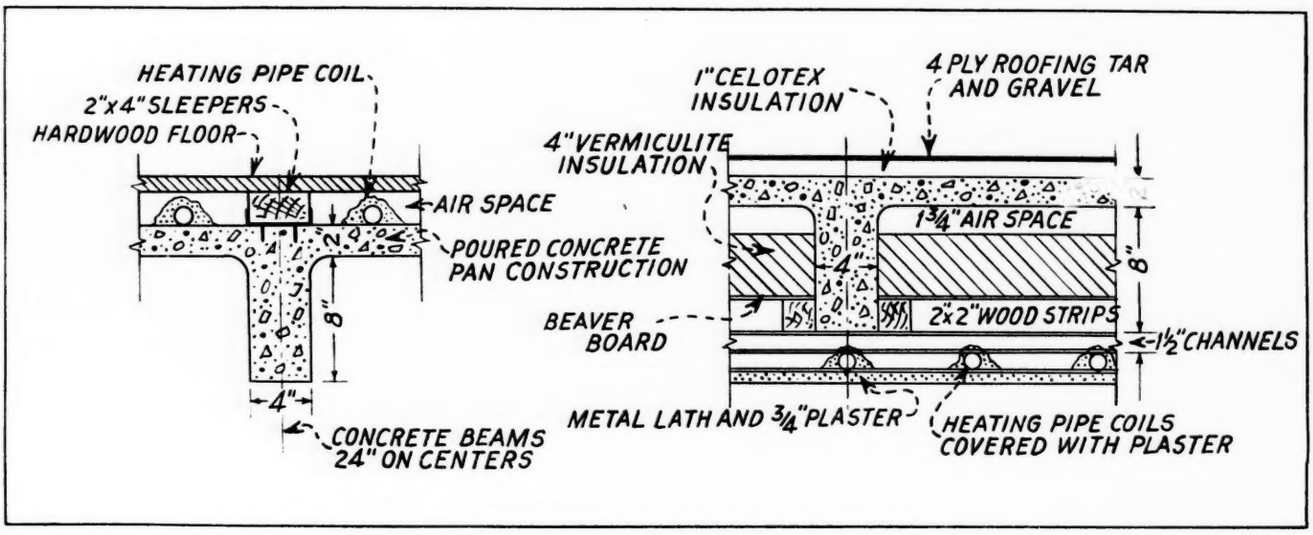


Fig. 2 (left). Diagram of first floor construction showing location of heating coils. Fig. 3 (right). Sketch of roof section with radiant heating coils installed below concrete beams.

Fig. 4. Living room ceiling with Byers wrought iron pipe coils installed.

beams 10 in. deep on 24-in. centers as shown in Fig. 2. The pipe coils for the heating system were laid on the floor slabs and cement was heaped over the pipe to give adequate contact and increase the radiating surface. Bull-dog clips were attached to the concrete to hold the 2 x 4 in. wood sleepers and the hardwood flooring was nailed to these wood strips. When solid floor construction was used, such as in the dining room and entrance, the heating coils were fully enclosed in the concrete as it was poured into the slab form.

The roof construction was also of concrete, as diagrammed in Fig. 3. Laid immediately over the concrete slab was 1 in. of Celotex board insulation which was covered with four-ply roofing paper and then tar and gravel. Wood timbers, 2 x 2 in. in size, were attached to each side of the concrete beams to support a ¼-in. beaver board sheet. The space between the beams was filled with loose fill expanded Vermiculite insulation to a depth of 4 in., which left a dead air space of approximately 1-¾ in. Light steel channels 1-½ in. in depth were installed to traverse the lower side of the concrete beams. The heating coils were suspended from these channels by wires as shown in the photograph of Fig. 4.

Expanded metal lath was then attached to the pipe coils as illustrated in Fig. 5, and the finished plaster ceiling was applied. Plaster was carefully pushed through the metal lath so as to heap it around the heating pipes. This was done to make a continuous and more intimate contact between the pipe and plaster, thus permitting the ceiling panel to radiate heat more uniformly. A heavy scrim similar to jute bagging, with approximately 8 meshes to the inch, was floated into the finish coat of all walls and ceiling until it was just barely visible. The scrim was

Fig. 5. Appearance of living room ceiling after metal lath was applied.

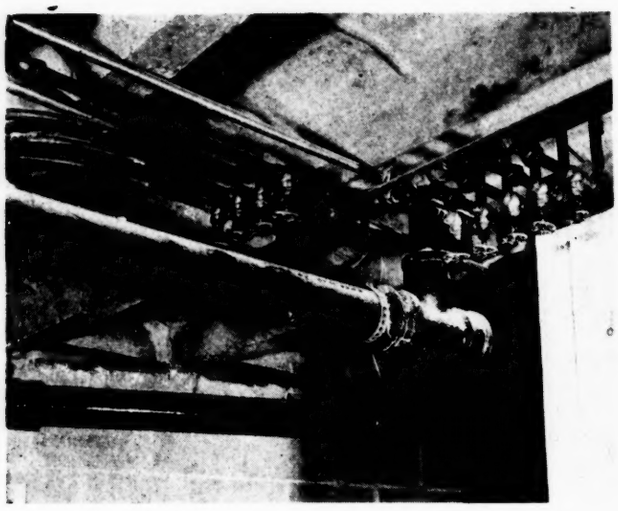


Fig. 6. The Iron Fireman stoker, American Radiator boiler and Sarcotherm control valve.

used to reinforce the plastered surfaces and prevent cracks from developing.

All of the heating coils were fabricated with Byers wrought iron pipe, which was selected because its coefficient of expansion and that of concrete or plaster was practically identical. In addition, the surface emissivity of wrought iron pipe was considered to be quite high and it also has good internal and external corrosion resistant characteristics.

The size of the residence is about 30,000 cu ft and it has a calculated heat loss of 130,000 Btu per hour with a temperature differential of 70F. There were 1945 ft of ¾-in. dia pipe installed and 100 ft of 1-in. pipe, which results in the equivalent of 541 sq ft direct radiating surface, exclusive of the necessary risers and distributing feeders. All first floor rooms were equipped with both floor and ceiling coils. Floor coils were not considered necessary for the second floor, since the upward heat radiation from the ceiling coils of the first floor was thought to be sufficient to keep the second floor surface warm.

Most of the heating coils were fabricated in the shop of the heating contractor, but a few coils were bent cold with a hand rig and welded at the residence. Particular attention was given to installing the coils so that the proper pitch for drainage would be provided. Before the system was placed in operation, all of the welded joints and other connections were subjected to a pressure of approximately 175 lb per sq in., and during this test all of the joints were rapped with a hammer to insure leak-proof connections.

The 24 pipe coils are individually controlled by valves grouped on three headers in the basement, one of which is shown in Fig. 7. A few of the coils on the second floor ceiling are grouped together on a single feeder from the basement and then divided by separate valves which are located in the bedroom closets. With all of the coil valves conveniently located, it is quite simple to adjust the quantity of water circulated to each coil and thus balance the entire system to give uniform and desired results.

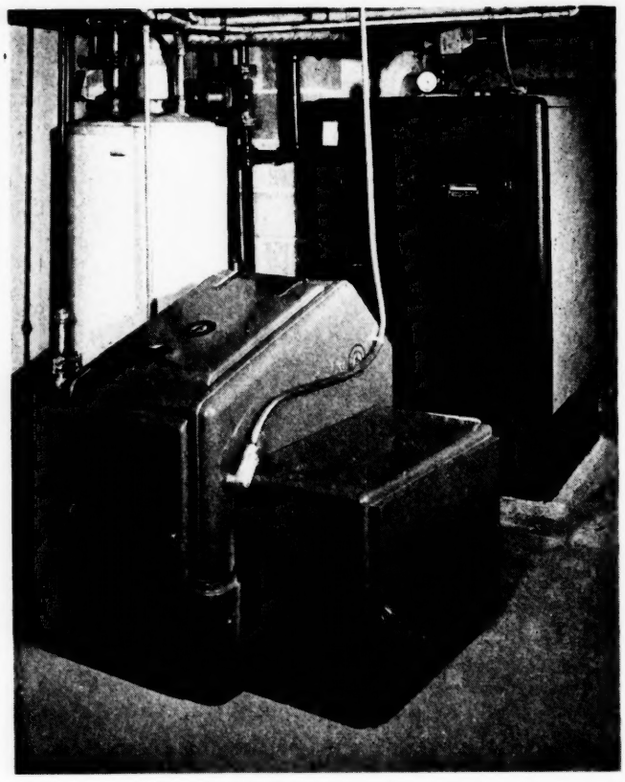


Fig. 7. One basement header with some of the control valves used for regulating the flow of water to pipe coils.

The coil returns have also been brought back to two common headers located in the basement. Each of these return headers is vented to a 3-in. pipe section located at a point above the second floor ceiling coils, which acts as an air relief and spill-over chamber. A drainage connection to an upstairs shower bath is provided for each one of these air relief sections. In addition, an expansion tank, pressure reducing valve and pressure relief valve are provided in the basement as is customary in other types of forced hot water heating systems.

Equipment and Control

Hot water is the heating medium circulated through all of the radiant pipe coils and this is heated in an American Radiator Red Flash Boiler No. 2-W-8 designed for a hot water load of 1860 sq ft radiation. The boiler, shown in Fig. 6, is fired with a 35 lb Iron Fireman anthracite ash removal stoker (hopper model), and rice coal is the fuel burned. The Iron Fireman stoker controls are arranged to keep the fire alive and maintain the boiler water at a pre-determined temperature. Water is circulated through the system by a 1-¼ in. Thrush pump which is shown first above the domestic hot water tank in Fig. 6.

A Sarcotherm weather control valve located above the boiler in the water discharge pipe automatically controls the system to operate with fluctuations in outside temperatures and variations in indoor conditions. This control consists of a three-way valve which is designed to by-pass a varying portion of

the returned water to the heating system and automatically add the right amount of heated water from the boiler to maintain the correct pipe coil temperature to give the desired indoor comfort conditions. A liquid expansion thermostat, mounted on the north exterior wall of the home, hydraulically adjusts the opening of the three-way valve to compensate for outdoor temperature variations.

Any indoor over-heating is prevented by means of an electric thermostat, located in the living room, which functions by means of a heater coil to cause a liquid expansion bulb to also act on the three-way valve in such a way as to prevent further hot water being taken from the boiler. This effectively checks overheating, while at the same time maintaining the responsiveness of the system to outside temperature changes, because the pump continues to circulate hot water irrespective of the water temperature regulated by the three-way valve.

Results and Observations

Progress of the construction permitted enclosing the residence about mid-October, 1941, and operating the heating plant during plastering and inside furnishing. Operation of the stoker required about 12 tons of rice coal for the heating season ending in June, 1942. This fuel consumption was considered low in view of the fact that there were 6578 degree days in the area of Buffalo during the heating season of 1941-42. It was also found that the cost of the installation was only slightly greater than estimates obtained for a typical forced hot water heating system with conventional radiators.

Although the system was designed for a minimum outside temperature of 0F, the owner has indicated that the residence was quite comfortable during a severe week-long blizzard, which occurred in the Buffalo area early in January, 1942, when the outside temperatures dropped to — 10F for several days.

All floors have been reported to be quite comfortable to touch or stand on, irrespective of whether they were wood floors with carpeting or tiled floors in the dining room and kitchen. This was true even during severe weather, when the water circulating in the coils reached its highest peak.

Other features of the radiant heating system as installed have been observed, which include such items as the elimination of radiators or warm-air grilles, thus permitting the location of furniture at any place in the room and improved cleanliness due to the fact that the air currents are lower, thereby causing a minimum of dust particle movement or disturbance. Uniformity of heating throughout the residence at the desired temperature level has been noted at all times, irrespective of outdoor weather conditions, and the controls have proved quite adequate.

Sebastian J. Tauriello, architect of Buffalo, N. Y., designed the home, while the heating layout was prepared by Raymond Viner Hall, Port Allegany, Pa., architect.

Ventilation of New Harbor Steam Plant

The Los Angeles Bureau of Power & Light has completed a $9,000,000 plant, known as the Harbor Steam Plant, with particularly comprehensive ventilating and heating systems installed in the control house, laboratory, and other departments.

The main structure is divided into three sections: the turbine room housing a turbine generator which is the largest 3600 r.p.m. unit in the United States; the boiler plant, housing a Riley boiler with a capacity of 570,000 lb of steam per hour; and between these units is a six-story auxiliary bay divided into six floor levels accommodating laboratories and auxiliary machinery rooms.

The plant is equipped with seven different ventilating systems to service areas requiring individual air control. The principal ventilating system consists of two double outlet Utility Fan Co. exhaust blowers of 30,000 c.f.m. capacity, located in the monitor above the boiler room so that the flow of air is from the generator room at ground level, down through the condenser room in the basement, and out through the fans in the monitor room.

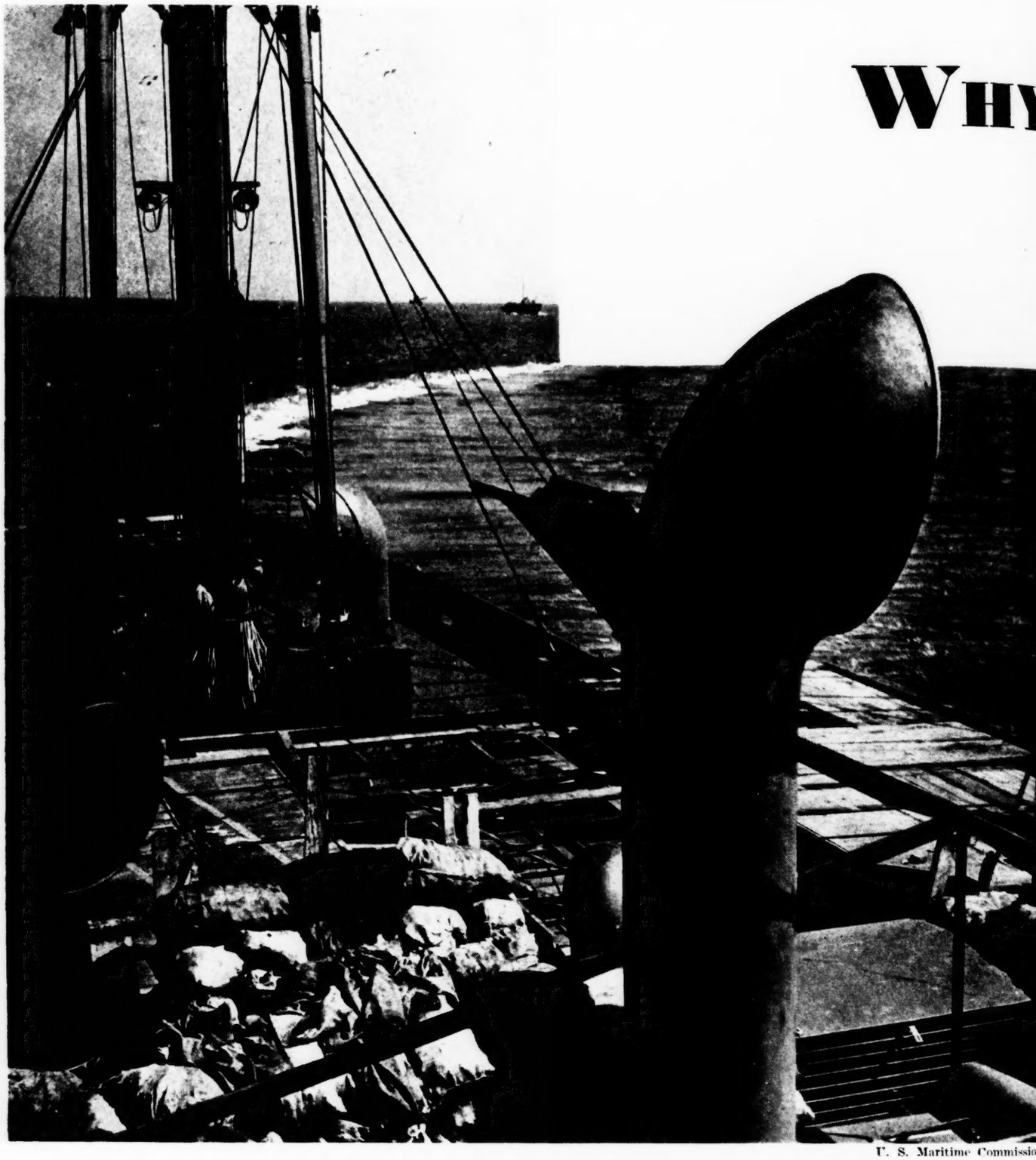
Six Robertson 16-inch ventilators are installed at the top of the auxiliary bay and take air through the stairway in the bay and through floor openings.

On the lower floors of the auxiliary bay a number of Wing Scruplex propeller fans, varying in diameter from 13 to 17 inches, have been mounted in the boiler-room wall to withdraw air from the auxiliary bay and supply it into the boiler room. A 5000 kw. transformer is installed in a closed room on another level of the auxiliary bay. To dissipate the heat a 32-inch Wing Scruplex fan is mounted in the wall to exhaust air from the transformer room. Air is admitted to this chamber through door louvers.

The auxiliary bay also contains a laboratory in which meters and gauges are repaired and fuel, water and steam analyses made. This department is equipped with a heating and ventilating system which takes air through louvers in the west wall of the bay, where it is drawn in by a 3700 c.f.m. centrifugal blower. This air is filtered through a Farr cleanable viscous filter. From the blower the air is passed through G.E. resistance-type electric strip heaters totaling 50 kw. divided in three steps, so that they come on to heat the laboratory in steps of one to three of the group, as required by conditions in the room. From the strip heaters, air passes into the duct system for distribution through grilles into various other rooms. Air is withdrawn from the laboratory section through hoods into a stack rising from the rear of the adjoining boiler room.

Heating and ventilating system was installed by Lohman Bros., Los Angeles.

WHY



U. S. Maritime Commissio

By John W. Markert

**Chief, Heating and Ventilating Branch,
United States Maritime Commission**

**The historical approach to a subject is usually as dry as d
In the accompanying article, however, the author uses
engineering history of marine ventilation to show
WHY of modern practice exemplified in ships designed
the Maritime Commission.**

Ship VENTILATION?

THE present practices used in ventilating ships were established as a result of a great deal of trial and error. Most of the methods used on land have been tried on ships at one time or another, some being successful and others unsuccessful. The successful ones became popular because they were either modified to suit the peculiarities of marine work, or because they were inherently suitable. On the other hand, the land practices which could not get their sea-legs commonly failed because the limitations which the job presented were not comprehended to the full degree.

The marine field is indebted to the land engineers for numerous original ideas. However, many problems which have always confronted marine engineers, have only recently taxed the ingenuity of industrial ventilating and air conditioning engineers. For example, the problem of ventilating windowless and blacked out structures is not new in marine work. In a sense, it may be said that the present war should give the industrial engineer greater appreciation of the problems common to marine work.

A ship is a self-sustaining institution. She creates her own power, feeds, houses, and entertains her crew and trade, and preserves the cargoes she carries, as well as the food and materials which she consumes. Those who can best mold these requirements into a single form, will most likely produce the best ship, whether the vessel be used for naval or commercial purposes.

A ship's ventilation system is an excellent example of arbitrary engineering. In the first place, we know that a ship can carry a certain total weight equivalent to the amount of water she displaces less her own weight. It, therefore, follows that weight and space saved in designing ventilation and other secondary equipment can be assigned to the prime purpose for which the vessel is to be used — cargo, passengers, armament, etc. In the second place, the amount of power required for the ventilation system must be balanced against the additional weight of the generator capacity it requires. In the third place, the degree of refinement (comfort or industrial) must be balanced against the earning capacity of such accommodations. Some of these considerations definitely necessitate that ship standards be somewhat different from those used for land work. It should be noted, however, that like all standards, exception must be made where conditions differ from those upon which the standard is based.

The close relation between ship ventilating, heating, and insulating on ships is such that it is impossible to fully discuss one without referring to the other. However, as the two latter subjects have been discussed to some extent in a recent issue of this publication, a minimum treatment of these items will suffice at this time. Therefore, the following paragraphs are principally an analysis of the why and wherefore of marine *ventilation*.

Limitations of Natural Ventilation

The exterior of a ship is basically a watertight structure. The inherent buoyancy of this structure is increased by subdividing it longitudinally by means of vertical watertight partitions called bulkheads. In many cases the space between two watertight bulkheads is further sub-divided by horizontal partitions called decks, and some of the decks, including the weather deck, are always made watertight. It naturally follows that in general every effort must be made to eliminate openings in the hull and other watertight structures, which would require closing under abnormal circumstances, such as rough weather, collision, and penetration of the main hull structure.

The only means available for natural ventilation of such a structure are airports, skylights, and downcomers located where water normally cannot impair their operation. In a few cases on very large ships small windows can be provided, where the space is well above the waterline and protected from direct contact with the sea. The inadequacy of such ventilation can be shown by merely noting the fact that the average airport is 12 in. in diameter, and the largest window on a ship is about 24 in. by 24 in. Except for the main public rooms, only one or two such small openings are provided for each space. Structural as well as watertight considerations necessitate the use of so few and such small openings. In rough and stormy weather it is frequently necessary to close the airports and windows. Also, airports in the main hull structure are now eliminated because of the danger of torpedoing when time is not available for closing the airports even if the construction were strong enough to withstand the resulting shock. Today, all airports, windows, and other openings for light and air, must be made light-excluding. Obviously the louver and baffle arrangements required to achieve this considerably reduce their (the windows, airports, etc.) effectiveness as ventilators. The necessity for providing adequate mechanical ventilation today on ships sailing to all parts of the globe is an obvious necessity.

General Ventilation Requirements

A ship has frequently been compared to a floating hotel. This is true in the same sense that a ship possesses living accommodations, commissary spaces,

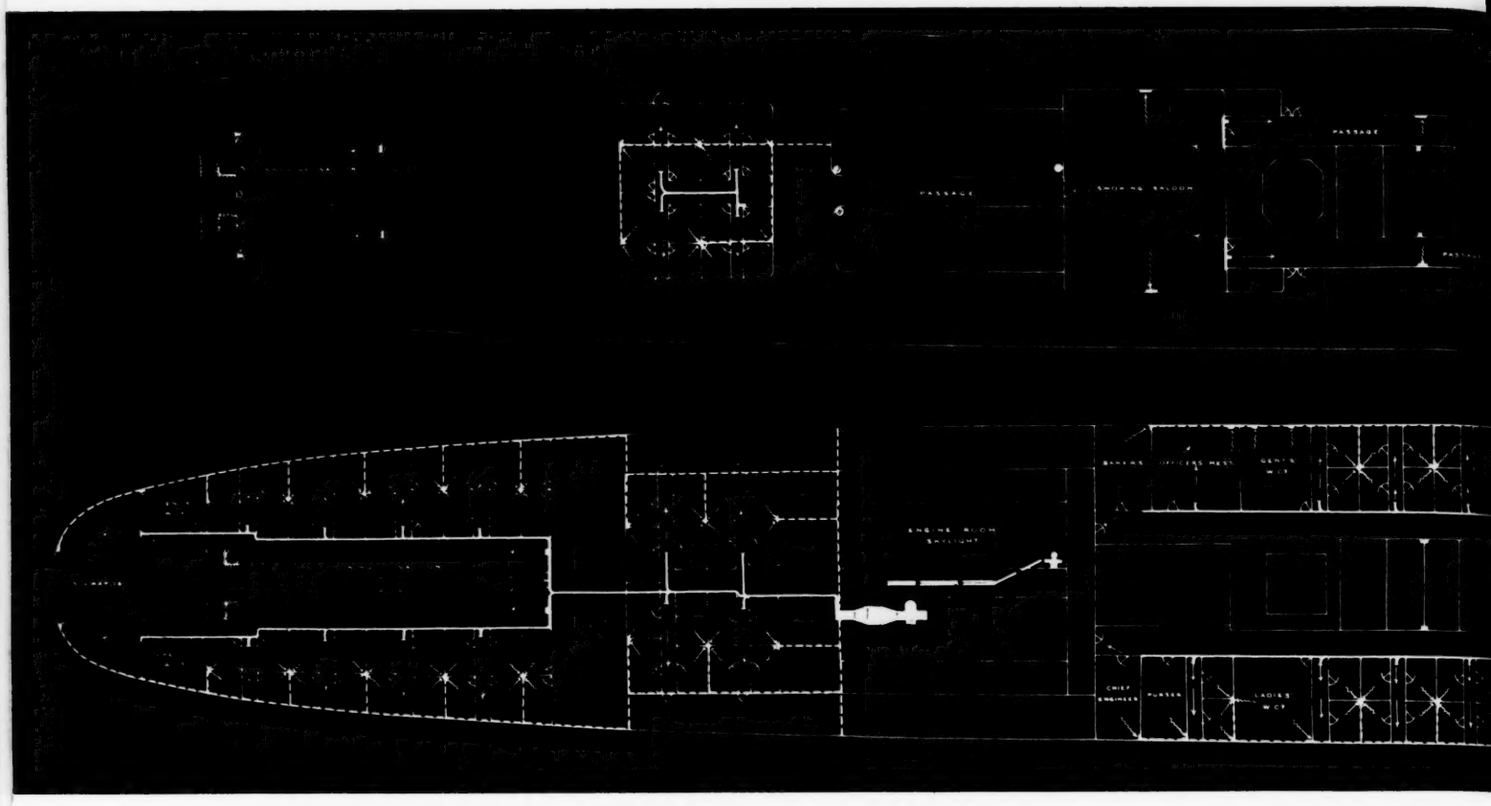


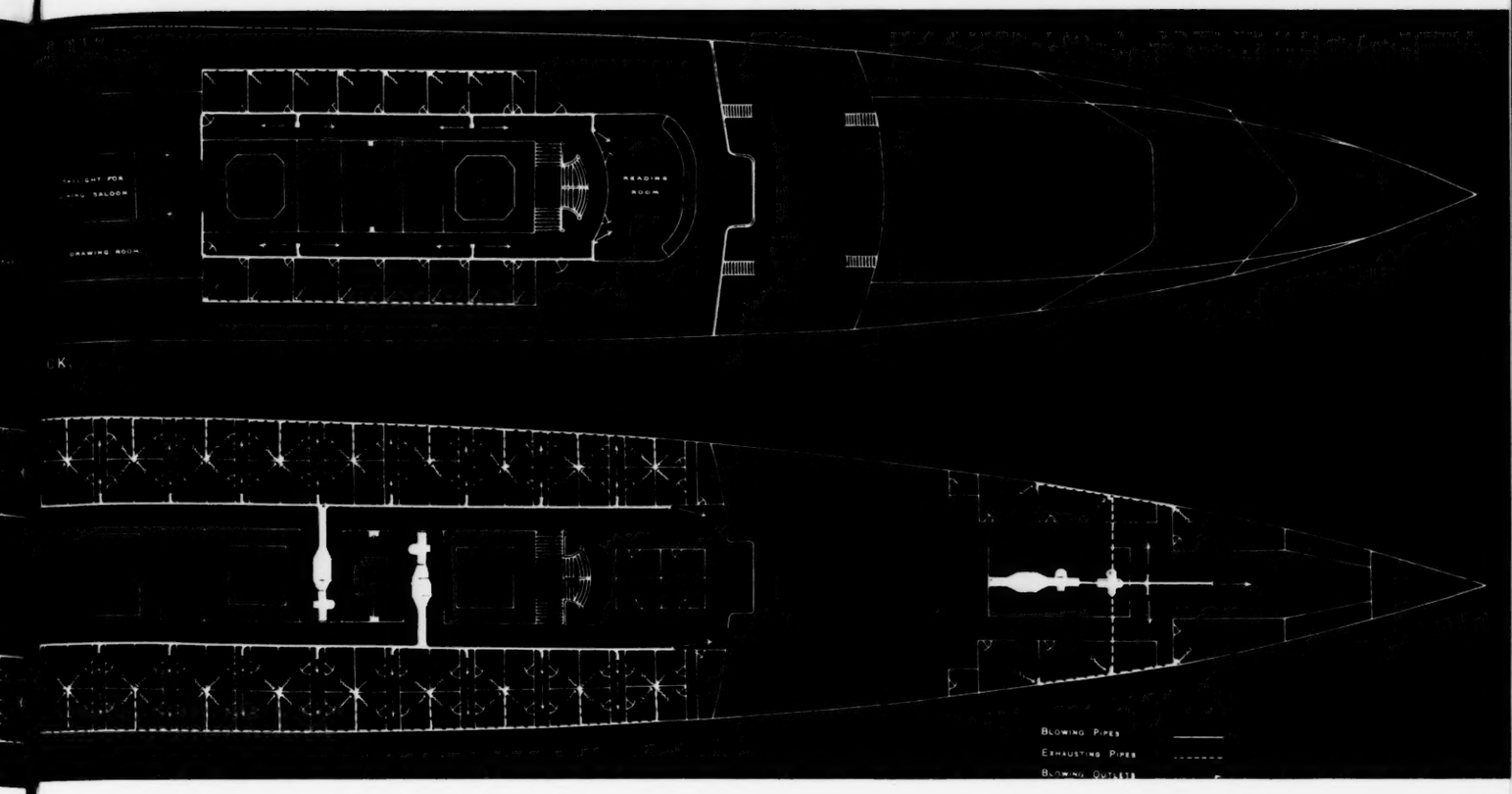
Fig. 1. Diagrammatic plan of systems proposed for heating and ventilating a large passenger liner. This plan formed part of a paper delivered before the North East Coast Institute of Engineers & Shipbuilders (England) in 1901. In actual practice, about ten supply systems (instead of the four shown) would have been required for the upper deck in order to obtain reasonable headroom, space limitations, etc. Similar factors would have necessitated greater subdivision of the exhaust systems than that shown. The ventilation and heating systems are of the "Plenum" type, mentioned in the text. The equipment arrangement proposed is shown in Fig. 3.

dining rooms, machine shops, and power plants which make her self-sustaining for long periods of time. Besides the above spaces there are large and small storage spaces, gymnasiums, and so on.

Each space on a ship must be dealt with according to the particular requirements of its use. While the ventilation of many spaces is based on empirical calculations, such as, air change and number of occupants, the ultimate result must be such that the air purity, temperature, humidity, and other psychrometric properties of the air in the space are within certain limits, based on acceptable standards. The cooling and heating load must be estimated, where temperature is important, based on the usual factors. In addition, the cooling effect of the water (through which the vessel is sailing) must be considered if the space involved is near or below the waterline. Maximum and minimum water temperatures of 85F and 35F are usually used for such calculations. This factor is important enough to justify the omission of ventilation from certain spaces which have only small heat gains and do not require fresh air to prevent deterioration of the materials and equipment housed in the space.

The relation between supply and exhaust ventilation depends on the type of space, and the relation of the space to the weather. In any case, it should be remembered that positive means for natural supply and exhaust must always be provided where natural ventilation is anticipated, because infiltration or exfiltration via open doors, windows, airports, etc., cannot be considered adequate for this purpose. Staterooms and similar small living and working spaces are usually provided with mechanical supply. Louvered doors are used for exhausting the air from these spaces to adjacent passageways and toilet spaces. Passageways may have either mechanical or natural exhaust. Toilet, shower, and similar spaces have mechanical exhaust to concentrate effluvial elements. Galleys, pantries, laundries, and cafeterias require spot cooling for working stations and abundant mechanical exhaust to concentrate and remove the heat generated by equipment. These spaces are much more compact than similar spaces on shore, and for this reason the problem of providing satisfactory working conditions is much more difficult. Berthing and messing spaces require the removal of great quantities of sensible heat (solar, body, light, etc), odors, and vitiated air. Such spaces always require considerable mechanical supply ventilation. Mechanical exhaust is also provided in many cases, particularly when the space is remote from the weather, so that very large exhaust trunks would be required if natural ventilation were used.

Machinery spaces vary greatly in their ventilation requirements. Also, careful consideration must be given to the spaces surrounding the machinery room, for it has frequently been found that while the latter is adequately ventilated, the former are overheated due to excessive leakage of hot air through machin-



ery space access openings, and heat transfer through the bulkheads, hangers, and equipment. Mechanical ventilation is provided for machinery space by spot-cooling in sufficient quantities to maintain livable temperatures at working stations. The method and quantity of exhaust depends on many factors; such as, the ease with which adequate natural exhaust can be obtained, the amount of air exhausted from the space by the equipment (diesel engines, force draft fans, etc.), the amount of power available for ventilation purposes, and similar considerations. When mechanical exhaust is considered essential to prevent leakage of the hot machinery space air into surrounding living spaces, the total volume of air supplied to the space (by the ventilation system) is slightly less than the total exhaust from the space (ventilation, combustion, etc.) in order to create a slight vacuum in the machinery space, and compensate for the greater volume of the vitiated air. A well designed mechanical exhaust system also serves to eliminate hot air pockets which would cause very high temperatures within and outside the space itself.

It should be noted that hot blast heating is most commonly used on ships. This factor alone often determines whether a space should be fitted with mechanical supply rather than exhaust. Where other considerations necessitate the use of mechanical exhaust (and natural supply) direct radiation or unit heaters are provided.

Most ventilation systems are down feed, because it is necessary to introduce the air into the structure from as high above the waterline as is practical, and because in many cases the deck heights are such that it is impossible to use horizontal ducts over 8 in. deep. In most cases on merchant ships the spaces served by a ventilation system are all within the same watertight subdivision. On passenger vessels which have been divided into fire zones, the systems must also be laid out to maintain the integrity of such boundaries.

A Bit of History

Mechanical ventilation was first used on board ship about sixty years ago. At this time it was considered most essential to dilute unhealthful concentration of carbonic acid, and thus the standards for ventilation were based on this consideration; temperature rise and air motion were of secondary importance. The two popular methods of ventilation used at this time were both based on the assumption that the removal of carbonic acid, which accumulated close to the ceiling, was of primary importance. Each of these systems had its particular advantages and disadvantages. The first system, commonly referred to as the plenum system, supplied air by means of fans to corridors and passageways. Jalousies or slatted doors permitted this air to be forced into the staterooms from which it exhausted naturally through ports, windows, or ventilators. The second system, known as the extraction system, mechanically exhausted air directly from the staterooms, the air entering through airports, windows, or slatted passageway doors. The chief advantage of the former was that it greatly reduced the amount of distributing ducts, while the chief disadvantage was that a large proportion leaked out through unanticipated openings. The chief advantage of the latter was that it positively exhausted a certain amount of

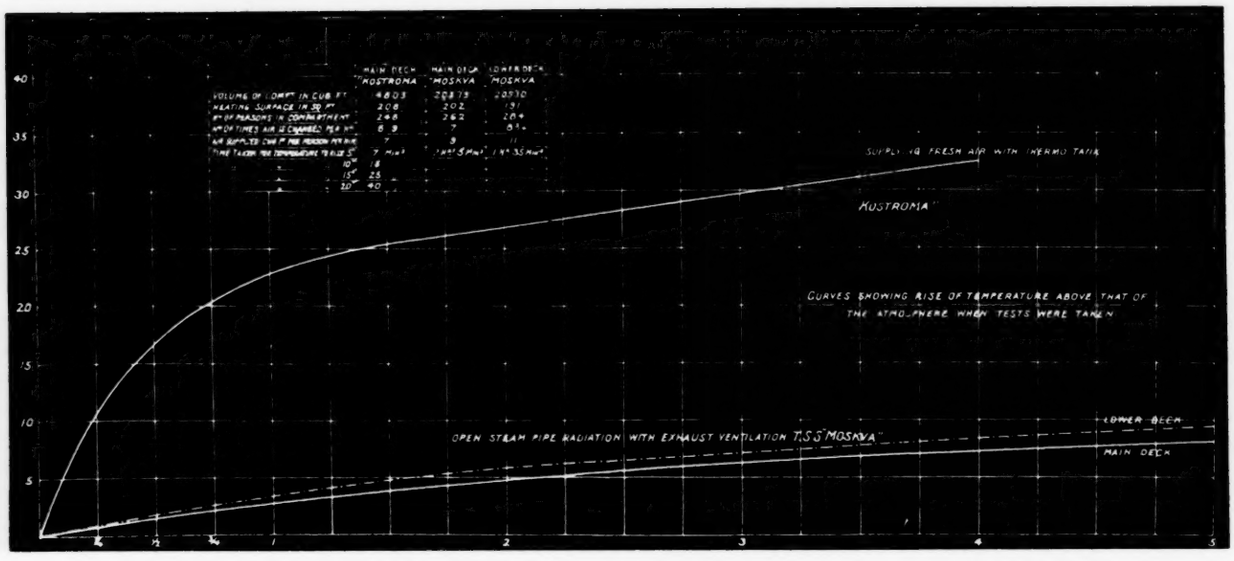

KUSTROMA
CURVES SHOWING RISE OF TEMPERATURE ABOVE THAT OF THE ATMOSPHERE WHEN TESTS WERE TAKEN
OPEN STEAM PIPE RADIATION WITH EXHAUST VENTILATION T.S.S. "MOSKVA"
LOWER DECK
MAIN DECK

Fig. 2. Curves showing relative performance of hot air (Thermotank) and pipe coil heating, based on actual tests made on two Russman Naval Vessels about 1900.

air through the ventilated space, while the chief disadvantage was that it frequently drew vitiated air (often from the most effluvial parts of the vessel) into the treated space. The first system was most common abroad, while the second was most popular in this country. Sometime later a third system was introduced, which is similar to that used today, i.e., mechanical supply directly to the ventilated space, and mechanical or natural exhaust directly from the space, from adjoining passageways, or from surrounding spaces.

Prior to the introduction of mechanical ventilation, direct heating (first with gravity hot water and later with steam—exhaust in many cases) was commonly used. When introduced, hot blast heating was looked on as being capable of curing all the ills and weaknesses of these earlier systems, such as steam leaks, odors, slow heating up, and noisy operation. Naturally, the popularity of hot blast heating had a considerable effect on the methods of ventilation mentioned above. Like many other innovations, the first thought was to use the existing plenum system by merely heating the air as it passed over a bank of pipe coils. Just how much satisfaction the designer of these systems expected is not known, but by experience it was found that the system had the same short-comings as a pipeless furnace.

Proponents of the various extraction systems countered the demand for hot air heating by introducing a system which was popular for many years in Europe. This consisted of adding a nest of pipe coils to the existing fan system and two sets of bypass dampers which enabled the system to operate as a supply system during the heating cycle and as an exhaust system during the ventilation cycle. The manufacturer also recommended that systems be interconnected so that if a sudden drop in temperature occurred, one system could be used as a supply and the other as an exhaust, thus achieving recirculation and more rapid heating up. Also on some of these systems arrangements were made to pipe brine through the heating coils to accomplish cooling in tropical weather. Apparently no consideration was given to humidity.

Psychology has played no greater part in the industry than on board ship. As ships grew and became larger and wider, it became necessary to have inside as well as outside staterooms. Throughout the history of ship ventilation, these inside rooms have always been a great problem. It appears that a human being does not feel safe at sea even today unless he has some means for letting fresh air and natural light into the space he is occupying. Ventilation engineers have in the past attempted to allay this fear by providing an overabundance of mechanical ventilation. Before the practice of zoning was introduced to hot blast heating, much overheating occurred; therefore, in these staterooms air, heated to satisfy the heating load of outside rooms, was introduced in greater proportions to the inside rooms. The result of this experience led to the addition of separate cold air ducts for inside staterooms on several ships in service, and the ultimate use of dual duct systems on new ships. At the time of introduction, dual (or double) duct systems were already popular on land for hospitals and similar institutions. Some engineers still consider it the most satisfactory system for heating passenger accommodations. However, the present trend toward automatic control for individual staterooms, to say nothing of the installation complications of the dual duct system, tend to make it (the dual duct system) a thing of the past.

Today, with the almost universal application of electric motors for driving fans, one is inclined to discount the effect of the driver on the ventilation system's design. When fans were first used on ships, steam engines were used as the driver. It naturally followed that a few large systems were employed with the fans and engines located close to the boiler in order to reduce the amount of piping and simplify

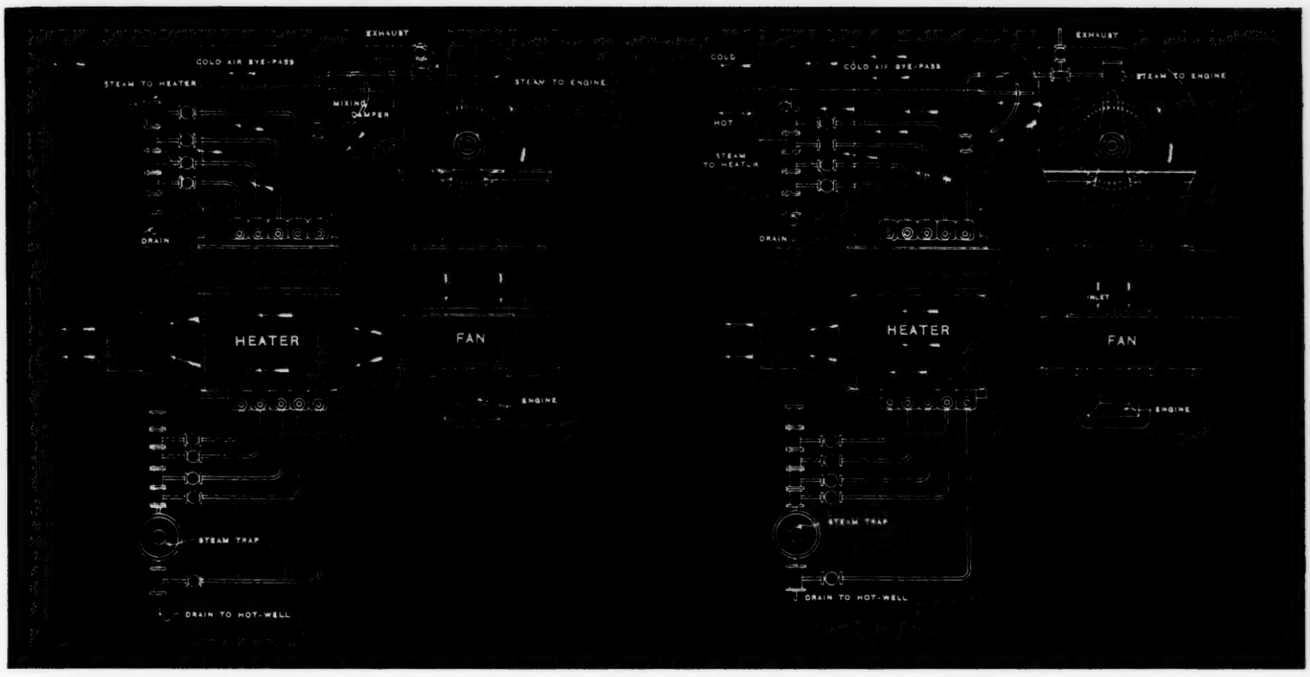


Fig. 3 (Left). Typical arrangement of fan and heater used with the obsolete "Plenum" system. Note that engine steam is used for heating (Pipe Coils). Fig. 4 (Right). Plan showing arrangement of heater and fan for dual duct system proposed for passenger ships in 1901.

maintenance. Probably the main disadvantage of this practice, from a purely marine point of view, was the fact that the main ducts were very large and had to pass through numerous watertight bulkheads, thus requiring large deck heights and many watertight closures. The introduction of electricity brought with it the use of motors for driving fans. This resulted in the application of many relatively small systems, giving better headroom and fewer, if any, watertight closures. It also followed that, if one fan was damaged, comparatively few spaces were left without ventilation. It is interesting to note that these considerations are more important on naval than on merchant vessels. In respect to this particular item, industrial engineers who are discussing pros and cons of centralizing and decentralizing air conditioning of large industrial plants may profit by the experience of naval engineers.

War and Service Requirements

In peacetime ships are frequently built with many frills and fancy touches, but the seriousness of the present day has pared everything down to bare essentials. Simplicity and reliability have always characterized marine work, and today this is more essential than ever before. The need for rugged construction, coupled with a minimum of weight, constantly competes with the general cry for conservation of critical materials. From the ventilation angle, this has resulted in a tendency toward higher duct velocities, fan and motor speeds, and allowable pressure drops through blast coils. Standardization of fans, motors, heaters, convectors, controls, etc., has been the natural outcome.

Every effort is made to eliminate cast iron in order to save weight and insure greater reliability. The substitution of steel for iron has not presented the problem which manufacturers generally anticipated, for many instances have occurred where manufacturers could not have supplied the great present day demands if they had had to rely on old-fashioned construction utilizing iron castings instead of newer drawn steel parts and steel weldments. Also, manufacturing costs have been appreciably reduced in numerous cases.

Hot dipped galvanizing has been considered essential for items such as fans, and heater casings, and certain wearing parts. However, many newcomers in the field are prone to minimize the importance of this requirement. It should be remembered that salt air is very corrosive. Use of galvanized sheet steel in lieu of hot dipped galvanizing after assembly is definitely unsatisfactory because working of the metal, attachment of fittings by riveting or welding, and raw-edges tend to void the value of the original coating. Zinc or cadmium plating has become popular for preserving parts previously made of corrosion resisting materials, which are too small to hot dip galvanize. Small non-working steel parts, when subject to normal temperatures, are frequently accepted with Bonderizing and a prime coat of special zinc chromate paint.

Some engineers have questioned the advisability of approving such finishes as electro-plating and Bonderizing, because of the difficulty of distinguishing between good and bad workmanship. The technical justification of these finishes, which permit conservation of critical materials, are numerous and, therefore, warrant their adoption in many cases.

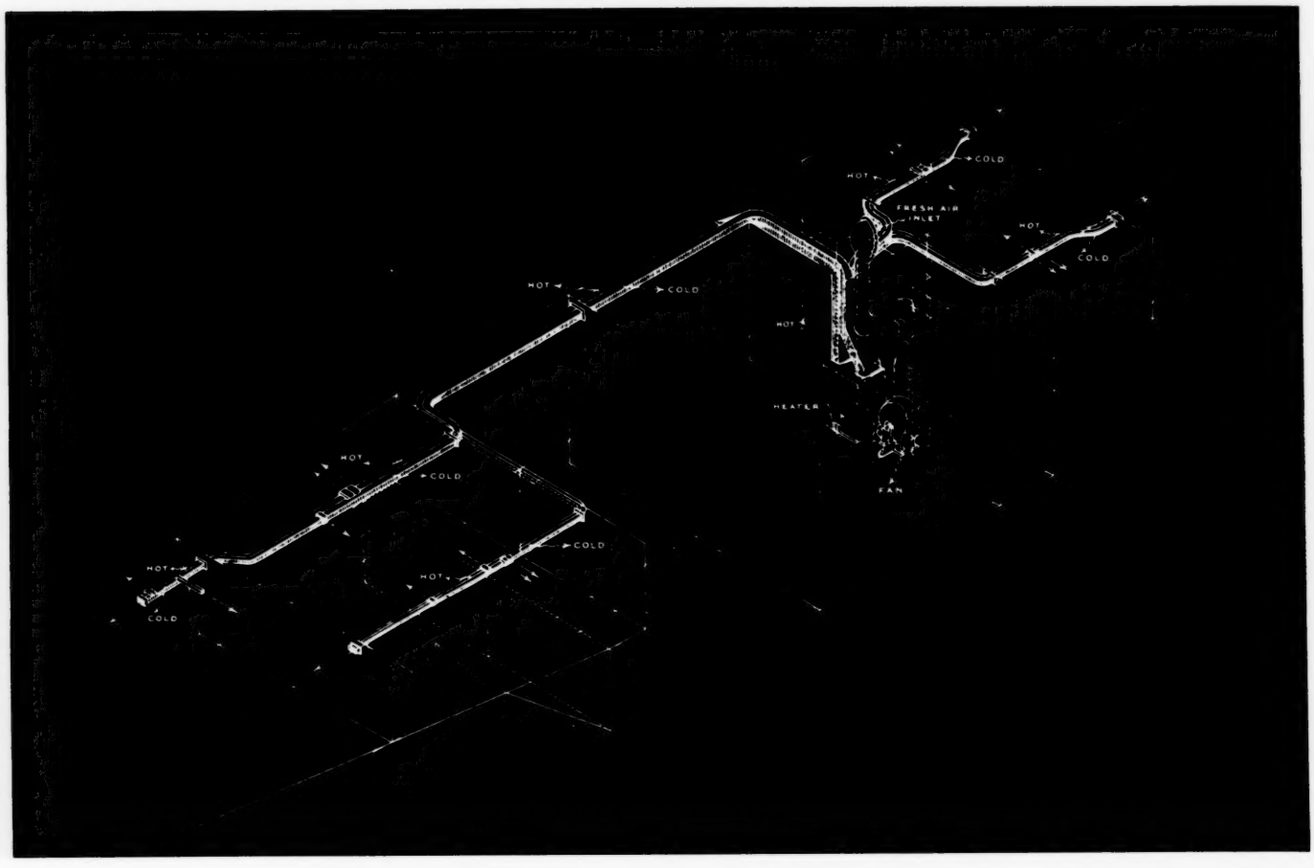


Fig. 5. Showing dual duct system installed on Dutch naval vessel prior to 1901. The arrangement of fan and heater is the same as that shown in Fig. 4, except for slight modifications required to suit space limitations. In practice it has been found essential that the hot and cold ducts be kept well separated to prevent heat transfer from one to the other.

The shipbuilding industry, of course, is important enough to be permitted to share many critical materials prohibited to other industries. Too often this has led to a misconception of conservation, and such action ignores the basic concept of what makes an item critical. A material is critical if the supply is not great enough to suit the demand. It follows naturally that a thing becomes less critical if the demand is alleviated by restricting its use to certain essential purposes. Nevertheless, if legitimate consumers do not control its application, then many or all of the essential uses may suffer. In other words, the question of what material should be used for a certain application is not that which is fundamentally best for the particular application, but that which is best for *all* applications requiring that material. Steel may be substituted for copper in some instances, not because it is best, but because it will survive for the duration At the same time it insures the supply of copper for those applications which cannot utilize steel. Thus, it may also be said that the marine engineer's problem today is not what to do it with, but rather what to do it without.

The term "black-smith engineering" has often been applied to the shipbuilding industry. However, the general tendency for requiring more rugged construction than that commonly used on land, is not necessarily unscientific. Science cannot ignore practical considerations, and ship design cannot ignore past experience. The motion and vibration of a ship play an important part in the design of the equipment it must carry. The unpredictable forces of storm and sea must be considered. Moreover, corrosion cannot always be protected by external protective coatings, and the abuse in service (cargo handling, for instance) is severe. In addition, today the element of shock must always be considered both from the ship's armament, and from external attack. A less important item which has increased in proportion to the activity in the industry, is that of handling in transit. Many articles, such as cowls, mushrooms, goosenecks, and screens are made by the shipyard in normal times. Today a great portion of this material is produced by outside organizations and shipped hundreds of miles. Even fabricated duct work is transported clear across the country from coast to coast. Perhaps by now, most manufacturers who have shipped materials of this type long distances agree that the ruggedness required at sea also serves a good purpose on land.

The present conflict is the first war to emphasize the importance of standardizing ventilation and heating equipment. During World War I, mechanical ventilation was used to a limited extent only. Consequently, the more universal application of mechanical ventilation and hot blast heating has made far greater demands on the industry in this war. The arguments for standardization are numerous, and

competitive bidding, in the common sense, cannot be retained where delivery and availability are more essential than dollars and cents. Standardization facilitates the ordering of materials at the earliest possible date. It also permits the designer to assign sufficient space and to complete details which normally would only be possible after the bid was let and the manufacturer's plans were submitted. Furthermore, it permits the manufacturer more time to produce, as the number of variables are greatly reduced, thus minimizing paper work and time-consuming custom-tailored design. It is believed that within a short time all of the principal equipment used for ship ventilation and heating will be standardized. Much of this work has already been completed, and the results of standardization to date have been:

1. A superior product designed particularly for the service;
2. Lower manufacturing costs;
3. Better and more reliable availability;
4. Simplification of specifications, preparation of plans and inspection; and
5. Faster construction and repair of vessels.

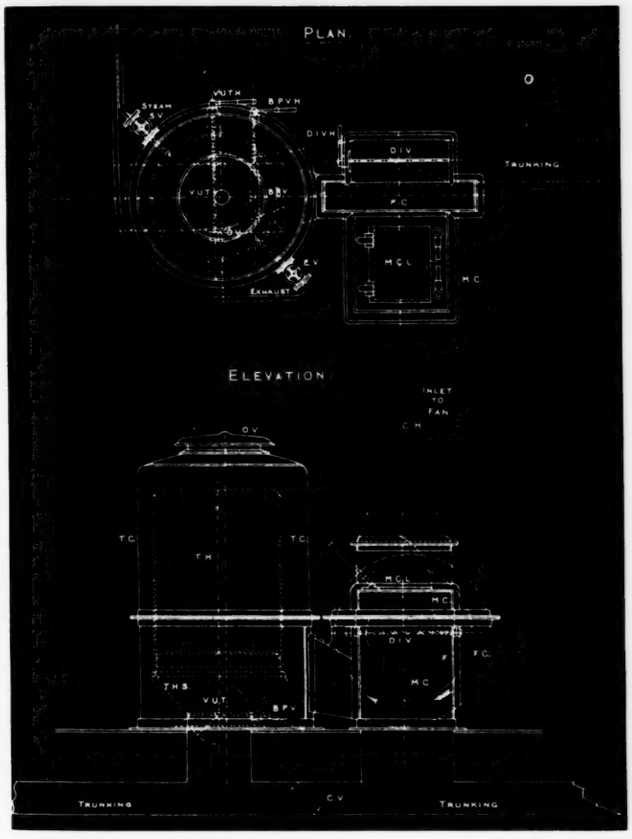


Fig. 6. Showing typical arrangement of Thermotank System (1901) when installed on open deck. The equipment operated as a vacuum system during the ventilation cycle. Readjustment of the dampers as required for heating, cooling and recirculation. Brine was circulated thru the heating coils in tropical weather. Two systems were commonly interlocked to permit recirculation during the starting up period, or as a guard against breakdown. Note that these systems were in use prior to 1900.

One for Two and Two for One

There is a tendency on board ship to design and install equipment so that it will serve a double purpose. This has affected the ventilation practice in several respects. As previously mentioned, the ventilation system is utilized for heating wherever practical. Also, many hollow structural members, such as masts, kingposts (the main vertical structure which supports the cargo handling gear, box-girders, etc., are utilized for ventilation purposes, and much may be said about the advantages of such a practice. Frequently, however, ventilation causes excessive condensation and thus accelerates corrosion, and, since many of these structures are subject to considerable strain, the danger of this action is quite apparent. Also, the size of openings (for ventilation purposes) is commonly limited to such an extent that it makes this practice somewhat undesirable. In addition, the location of these members is often removed from that best suited to ventilation purposes. In several instances, an effort has been made to find what determined the size of particular structural members of this type, and in most cases it came down to the old problem of the "chicken and the egg." There is no general rule for determining whether or not a particular structural member should also be used for ventilation purposes. Each case should be examined both from a structural and ventilation point of view. Frequently, those in charge of the structural and ventilation design each think they are doing the other a favor, thus resulting in a compromise which is undesirable from both angles.

Another dual purpose practice is the utilization of ventilation systems for two services. Frequently, it is convenient to ventilate hold spaces and winch resistor spaces with the same fan. Another example is the use of the steering gear room ventilation system for ventilating the capstan machinery and resistor rooms. Obviously, this arrangement is possible only when both spaces do not require ventilation at the same time, and usually when one space requires ventilation for a short period of time at long intervals thus making the installation of a separate fan uneconomical.

The sea water, too, is also utilized for a dual purpose. Insulation is frequently provided to prevent condensation. However, it has been found practical in some instances to omit the insulation, thus utilizing the full cooling effect of the sea water, the space involved being below the waterline. This cooling effect is great enough in some cases to eliminate the need for insulation which would otherwise be required to prevent condensation if humid air was introduced into the space.

Bulkheads, beams and decks are often used to form one or more sides of ventilation trunks. This practice is justifiable only where the weight and space saved are considerable. The inaccessibility of the interior makes this construction inadvisable for small sizes.

Just Around the Corner

By JOHN J. WOOLFENDEN
Engineering Staff of Smith, Hinchman & Grylls, Inc.,
Architects and Engineers, Detroit, Mich.

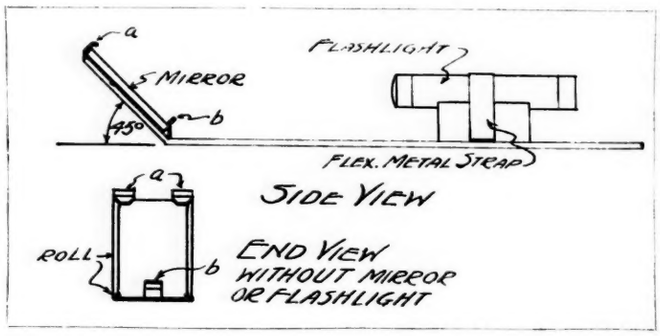
The author, a regular contributor to HEATING AND VENTILATING, has had a long and varied experience in engineering—as a designer, as field engineer, and as a teacher in engineering schools. Mr. Woolfenden some time ago consented to put in written form a number of the incidents, experiences, and anecdotes which make up a part of his rich professional background. This he has done, and the accompanying short story is the first of a series which will appear in HEATING AND VENTILATING from time to time. Each will be unrelated to the others excepting for their common ancestry.

MANY times in inspecting or checking up a ventilating system, it becomes necessary to examine the inside of a duct, to ascertain whether or not the damper quadrant properly indicates the position of the damper or whether or not there is some foreign matter which obstructs the flow of air.

In the case of a large duct, it is usually possible to obtain entrance to it through an access door and even to walk or creep through it, if necessary.

A small duct, however, is sometimes difficult to examine, even though the end be open, and for that reason, the writer had an arrangement made something on the order of a dentist's mirror, on a large scale, with provision for attaching a flashlight, or other source of illumination. This device permitted the examination of the interior of any straight run of duct, regardless of how small it might be—even 6 in. x 6 in was not too small—and without the necessity of obstructing the view by inserting a light, held in the hand, into the duct or obstructing the light, if held by an assistant, by the head in the position required to obtain a view of the duct interior.

The general scheme of this device is shown in the sketch. The original utensil was extemporized from lath and wood blocks in 1910, but, subsequently, one was made of metal by the courtesy of the superintendent of the sheet metal department of a contracting firm who also had one made for his own use.



By means of the original device, the writer examined the interior of about two hundred fume vent flues from the hoods in a chemical laboratory building. These flues were of fire clay tile, 4½ in. x 8½ in. outside measure, with hood connections of the same size. They ran straight through the roof and were from one to four stories in height. The purpose of the examination was to insure that none of them had become obstructed by mortar or other debris during construction.

Construction of the metal device was somewhat as follows. The stock used was about 28 or 30 gauge, galvanized sheet. The handle was about 2 in. wide and 24 in. long, with the edges turned, as shown in the end view. One end of the handle was turned up at 45 degrees and two small lugs or clips formed at the extremity and turned over; these are marked *a* on the sketch.

At the base of the bent portion, a small tongue was cut and bent upward and over, like a spring, as shown by *b* on the sketch.

The mirror, one of the small, circular, pocket type, about 3 inches in diameter, was held in place by the clips and the tongue, as shown.

The writer afterward fastened a small wood block, with a V-groove on top, to the handle, by round head screws. The underside of this block was slightly cut away at one place, to permit the insertion of a short metal strap; in fact, one of the usual pipe-covering bands. By means of this band, a small flashlight could be held in place on the handle, when desired. Of course, an extension cord, or any other suitable and convenient source of light could be used.

The light was deflected by the mirror into the duct, when the apparatus was in use, and the interior of the duct thus became visible to the observer looking in the mirror.

This apparatus might be improved and made more portable by having the head provided with a threaded stud to which a tubular or rod handle could be attached and, if desired, the handle, itself, could be made sectional, so that the whole thing could be readily carried in a brief case or even in an overcoat pocket.

The head of one of America's great engineering organizations explains what is being done- not just talked about—to win the peace by having industry so organized that work will be available for war workers and returning soldiers and sailors alike, when the war is won.

INDUSTRY *Plans* FOR THE FUTURE

by Paul G. Hoffman
President, The Studebaker Corp.
Chairman, Committee for Economic Development

IN mechanized warfare, the balance inevitably swings sooner or later toward the side with the greatest mechanical industry. We already have seen the beginning of that swing. The fact that it has started so soon is a tribute to the resourcefulness, ingenuity, and drive of manufacturing executives and workers alike in the war plants throughout the country.

Let us never for a moment forget, however, that equipment alone is not enough. It takes men willing to make the greatest sacrifice to put that equipment to use. Victories are not won by machinery itself, or by the men who produce it, but by the men using it on the fighting line. The only real heroes in this war are in the combat zones. We on the home front have been put to some inconveniences by the war, but we are making no real sacrifices in the sense that the men on the fighting front are.

We Have Two Jobs

It is our job on the home front to keep a stream of war supplies flowing to the fighting front; for without equipment, the finest leadership, courage, and fighting ability are hard put to win victories. While doing this, it is also our job to take practical steps to assure that we will make our maximum contribution toward continued high-level production when peace comes. This involves provision of jobs for our fighting men when they return, as well as the continuance of jobs for war industry workers. This is an obligation every one of us in America must assume. The men at the fighting front depend on us not to let them down.

War Has AAA Priority

The assumption has been made by some that there is a conflict between working to win the war and making preparations for peace. There should not be; there need not be; and there must not be. Winning the war has a triple-A priority. Nothing must be allowed to interfere in the slightest way with the gaining of that objective. Industrial preparation for peace, however, need in no way interfere with war production.

On the contrary, by giving assurance to war workers and fighting men alike that they will not be let down at the end of the war, confidence is created and morale is stimulated. American industry has progressed through its ability to plan for the future while doing an efficient job in the present. To assume that it cannot do so now is to deny the continued existence of one of the qualities that has made industrial America really great.

The assumption has been made by some that there is a conflict between working to win the war and making preparations for peace. There should not be — there need not be — and there must not be!

We have paid a terrific price in blood and sweat for being unprepared for war. We might pay an equally devastating price for being unprepared for peace. Taking no thought for the future at this time would put American conceptions of freedom in the great-

est jeopardy. We made the mistake in World War I of failing to prepare for peace. To repeat that mistake now would be more than stupid; because of the vast upheavals and dislocations prevailing in the world, it would probably be fatal.

Our hope of achieving a better world rests largely upon our ability to develop and maintain high-level peace-time employment and production.

For this reason, a Committee for Economic Development has been formed, the purpose of which is to stimulate individual initiative in developing practical means for continuing high-level employment—which, of course, means high-level production—with the minimum of interruption at the end of the war. This committee is giving special emphasis to the study of recent developments in materials, equipment, methods, and technique, particularly where these point to new possibilities in peace markets.

Problems of Peace

The problems that peace will bring are numerous and complex. In addition to international matters —monetary confusion, world policing, etc.—a large number of domestic policies need challenging in view of the new conditions that will prevail in the post-war world. But important as all these questions are, our hope of achieving a better world rests largely upon our ability to develop and maintain high-level peace-time employment and production.

There can be no better world unless America is strong and free. America cannot remain strong and free if, after the war, we have too much unemployment for too long. That would be a direct invitation to dictatorship; on that point there is general agreement. Perhaps it is not so clearly recognized that if Government furnishes too much employment for too long, the result will be similar. Too much Government employment results in staggering deficits, political corruption, and deterioration of the character of our people. Either too much unemployment or too much Government employment will mean regimentation to replace free enterprise; our free society would give way to some form of state socialism.

When the Committee for Economic Development was organized, its members realized that if they hoped to make any contribution to the solution of the post-war employment problem, their first job was to establish the facts. To develop the facts, they went back to 1940, our last peacetime year. It was found that approximately 46,000,000 people were gainfully employed in the United States in that year; less than 600,000 were either in the Armed Forces or engaged in armament production. It is estimated also that from 6,000,000 to 9,000,000 competent workers were unemployed.

In contrast to 1940, it is estimated that by the end of this year more than 62,000,000 people will be employed in our fighting and working forces, of whom no less than 20,000,000 will be engaged in the manufacture of war equipment. If we had to provide employment for this large number after the war, the task would be staggering; but this is not likely.

Assuming that several million women, along with over-age and under-age men, will return to their homes when the war is over, economists estimate that we will have to provide 58,000,000 jobs with a normal work-week to have a satisfactory level of employment. Approximately 2,000,000 of these will be in the Armed Forces. The Government normally employs approximately 3,000,000 people.

In addition, there will be an obvious need for a post-war public works program. Highway building and maintenance has been neglected, so that our highway system will have to be reconstructed to a large extent in order to meet modern traffic conditions. New residential building and slum clearance will necessitate modernization and new construction of such essential services as water works. The expansion in civil aviation will require a huge airport construction program. All of this, it is estimated, will employ about 3,000,000 men. This leaves about 50,000,000 people who will be looking to industry, commerce, agriculture and the professions for work.

Inescapable Conclusions

That is the goal as far as jobs are concerned. High-level employment could be attained very easily if we disregarded the reasons for its attainment—a high standard of living and the maintenance of age-old American freedoms. A twenty-hour or even a thirty-hour week might cure unemployment, but at the same time might plunge America into poverty. Jobs might be created by turning our backs on technological advances—but at what cost to our living standards! The only way in which we can attain the triple objectives of high-level employment, high-level production, and high-level living standards is by taking advantage of every technological advance.

To attain the triple objectives stated, we must increase our gross output of goods and services more than 40 per cent over the record-breaking peacetime year of 1940. In that year, our gross output was $98,000,000,000. After we have made the transition to peacetime production, our annual output must be approximately $140,000,000,000, measured in terms of the 1940 dollar. If we face these facts, two conclusions are inescapable:

1. Individual enterprises must start *now* to plan their own peacetime products for peacetime markets.
2. The environment in the post-war period must

be favorable to the expansion of enterprise. Policies of Government, business, and labor must be directed toward the achievement of a more dynamic economy.

How can this be accomplished? First let me say that I have no confidence whatever in the ability of any agency—public or private—to make over-all plans for our economic system or business program. However, I have the highest confidence in the ability of individual business men to plan for the future of their own business. The initiative and resourcefulness of the individuals in this country constitute one of our greatest national resources. The problem is how to develop this great resource and how to stimulate hard thinking on the part of business men.

There will be an obvious need for a post-war public works program. New residential building and slum clearance will necessitate modernization and new construction.

Composition of Committee

The Committee for Economic Development is composed of a board of eighteen trustees, twelve regional chairmen, and approximately one hundred district chairmen. The committee is independent and self-financed, but has the active support of the Department of Commerce. Furthermore, it has been assured the cooperation of other governmental agencies and of great national business organizations.

The responsibility for the committee's activities rests with its Board of Trustees. Its activities are carried out through two major divisions—the Field Development Division and the Research Division. Marion Folsom, treasurer of the Eastman Kodak Co., a member of the Board of Trustees, heads the Field Development Division; Ralph Flanders, president of the Jones & Lamson Machine Co., also a member of the board, heads the Research Division.

The Field Development Division has the responsibility of stimulating, encouraging, and helping individual enterprises in planning their post-war products and marketing. There are actually 3,000,000 business establishments in the United States, but of these approximately 1,000,000 are one-man concerns; of the remainder, 1,850,000 employ from one to eight persons, and 150,000 employ from nine up. Approximately 500 concerns may be classified as large employers.

The efforts of the Field Development Division are directed toward the smaller, as well as the larger, businesses, because the former provide many millions with their livelihood. Furthermore, it is the smaller businesses that need most encouragement and help, and all possible cooperation should be extended to them because they are essential to our country. Employers, large and small, are the shock troops on whom we must rely to plan for the sharp increase in production that will, in turn, provide high-level peacetime employment.

The first effort is to provide "know how" information to all business men. To this end, an Industrial Advisory Board has been appointed, which is composed of our foremost experts, not only in the field of planning for individual enterprises, but from the standpoint of knowledge of new materials and technological methods. The studies of Dr. S. M. Livingston under the title "Markets after the War" are an important part of this work.

Collecting planning information is only one of the functions of the Field Development Division. It must also be distributed as widely as possible. This is done in three ways: First, through direct contact with the large corporations; second, through trade associations; and third, through community activities.

The setting up of local Committees for Economic Development presents the greatest difficulty, but also holds the greatest promise. If the right community leaders can be secured, very little help will be required from our national committee. The goal is approximately one thousand local committees. To obtain distinguished local leadership, the cooperation of prominent men in business and industry has already been secured. The national committee asks for no authority over the regional, state, or community chairmen, but it is strongly urged that the local committees be sponsored by, or collaborate with, existing organizations. In most cities, the committee works closely with the local Chamber of Commerce.

The national committee stands ready to extend all possible assistance to the local committees. In return, the local committees give the national group the benefit of whatever new ideas they may develop, so that these can be passed on to other local committees. This plan of operation has already been found to be well justified. Perhaps out of a small western town may come an idea that will mean jobs for thousands in New York—who knows?

Work of Research Division

The Research Division is concerned with the creation of conditions in the post-war period favorable to the expansion of enterprise. All policies of Government, businesses, and labor that interfere with expanding employment should be challenged and changed. All policies should be considered only with reference to the general public welfare.

As mentioned, the research group is headed by Ralph Flanders, who combines clear vision with hard common sense, and who has associated with him a group of eminent business leaders. This group coop-

erates with a Research Advisory Board.

In setting up this division, as stated, the committee recognized that the criterion by which the policies adopted should be judged is that of the general public welfare, and therefore, did not suggest that studies of these policies should be undertaken by business men who, consciously or subconsciously, might be prejudiced. They proposed rather that a research staff of university economists be organized and instructed to carry forward studies, with the sole objective of suggesting changes that would help us maintain a free and dynamic society.

Among the research projects now under way are the following: Incentives for business enterprise and the effect of taxation on those incentives; post-war reconversion problems; cancellation of war contracts; disposal of Government-owned plants and surpluses; removal of wartime production, inventory, rationing, and price controls and priorities; monetary and banking policies; changes in the tax structure; financing reconversion and rehabilitation of industries; transfer of workers to peacetime jobs; provision for unemployed workers during the transition period; post-war problems of agriculture and of international trade and finance; and a survey of the special problems pertaining to small business.

The committee hopes to attain worthwhile results by bringing together business men and economists, and by making use of the practical experience of the former and of the detailed studies of the latter. Any policies of business that are not in the general public interest should give way to new conceptions, as should also any such policies of Government and of labor. *We may win the war, but we will not "win the peace" unless business men are willing to be Americans first and business men second. Similarly, labor leaders must be Americans first and labor leaders second; and this also goes for the farmers and the Government administrators.*

The Prospect is Hopeful

This, in brief, is the way in which the Committee for Economic Development is endeavoring to help commerce and industry to get ready now to provide employment when peace comes. The prospect is hopeful because peace, when it comes, will find a huge pent-up need and desire for goods, and billions of dollars of savings available to permit people to translate their desires into buying demand. The problem of industry will be to meet the demand, not to create it. The prospect is inspiring because, in Donald Nelson's words, we are on the edge of a new world—and what a chance we have to make that a better world than we have ever known in the past, the kind of world that really was worth fighting for.

Business must be ready to act quickly and surely when the time comes. That is why we must plan now and plan boldly. When once peace comes, industry must be ready to race to high-level employment. Industry and other segments of the economy must be ready to provide jobs for millions of returning servicemen and idle war workers. This must be done before long unemployment brings fear and disillusionment and want. If business has planned boldly and has the courage to act boldly when peace comes, its wheels can begin to turn in time.

This is an obligation that rests with employers—large and small—an obligation that we cannot escape. Men are fighting and suffering and dying all over the world to protect your freedom and mine; the least we can do is to assure them a better post-war world, a world not only of security, but of security with opportunity.

The only way we can attain the high-level employment, high-level production, and high-level living standards is by taking advantage of every technological advance.

Pipe and Chimney Friction Coefficients

When a pipe becomes encrusted with scale, or after its interior is coated with slime, it makes no difference whether the pipe is made of cast iron, steel, brass, or gold. It is logical that the coefficient of friction must be the same after the pipe is once coated. Before the surface is fully coated it is true that there is a difference, but it is evident that where coating occurs the friction created by the coat must be considered and not the coefficient of friction of the metal. Yet in many formulas the material or metal is specified by authors rather than the coating.

The same applies to chimneys. After the interior of a chimney is once coated with soot all chimneys become alike so far as friction is concerned whether they are made of brick, concrete, or steel. Yet we commonly find formulas that designate different coefficients of friction for the various materials. Such formulas should be avoided—*W. F. Schaphorst.*

By E. N. KEMLER
Professor of Mechanical Engineering, Purdue University, Lafayette, Ind.

A SIMPLIFIED method has been developed for the determination of the pressure drop of compressible fluids[1] which was based on correcting the values obtained from the formula normally used for liquids. When applied to compressible flow the normal formula for incompressible flow can be written as

$$\frac{p_1 - p_2}{p_1 l} = \frac{43.75\, f\, v_1^2\, \rho_1}{p_1 d^5} \quad \ldots\ldots\ldots\ldots (1)$$

where p_1 = inlet pressure in lb per sq in.,
p_2 = discharge pressure in lb per sq in.,
f = friction factor,
v_1 = cubic feet per second at inlet pressure,
ρ_1 = density at inlet pressure,
d = inside diameter in inches,
l = length of the line in feet.

The friction factor is a function of Reynold's number and can be found by the methods given in the above mentioned article. It can be shown that when the weight rate of flow is fixed, the friction factor will also be fixed for the particular pipe for isothermal flow conditions. If the density at inlet conditions is expressed in terms of the pressure

$$\rho_1 = \frac{p_1 \times 144}{RT_1}$$

where R is the gas constant, and T_1 is temperature of gas, F abs.

Equation (1) will reduce to the form

$$\frac{p_1 - p_2}{p_1 l} = \frac{43.75\, f\, v_1^2 \times 144}{RT\, d^5}$$

The correct value for pressure drop ratio can be found from Fig. 1, if the approximate value as determined for the above formula is known. Even when such a simplified formula is used the calculations are involved. It is possible to design a series of charts for the above equation for commercial pipes. The accompanying charts (Fig. 8 to 14) give in as compact form as possible a means of solving compressible flow

[1] See Heating & Ventilating, August, 1942; Pressure Drop Calculations for Flow in Pipes, by J. A. Hardy and E. N. Kemler, pages 43-49.

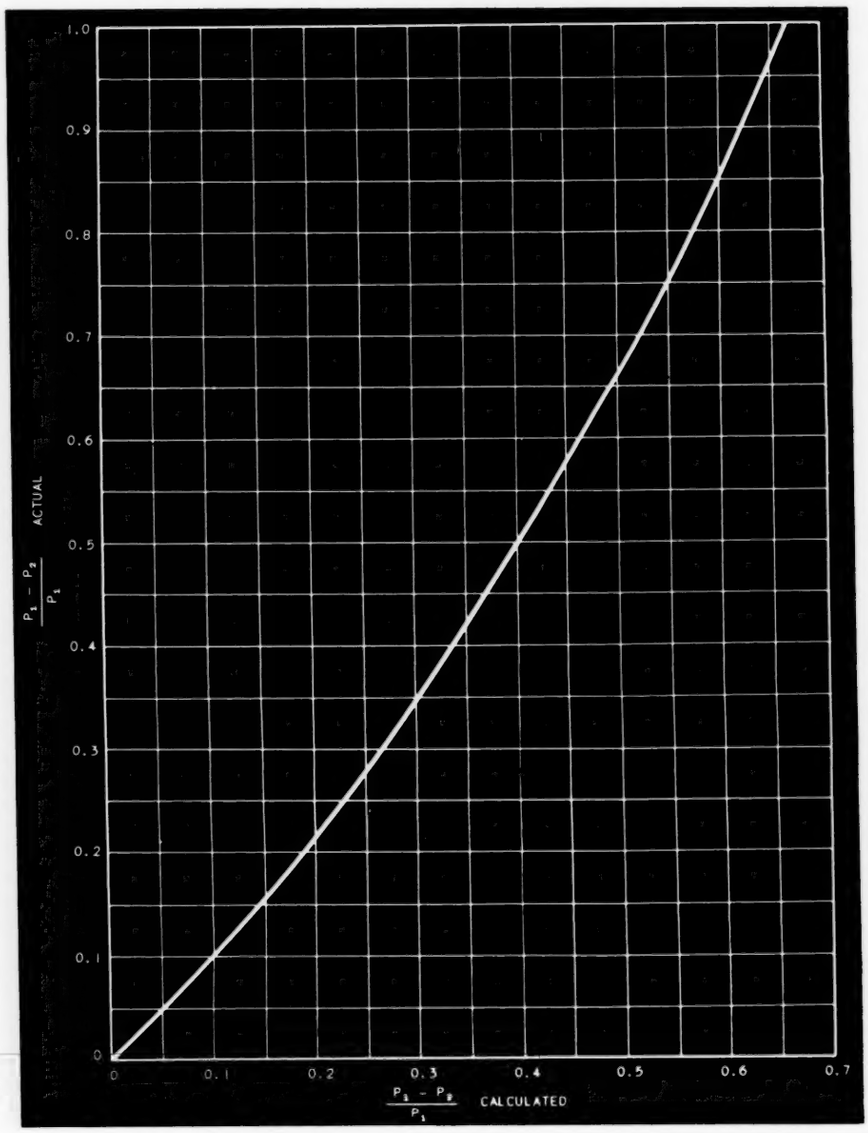


Fig. 1. Correction chart for pressure drop ratio.

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problems. The charts also serve as a convenient conversion chart.

These charts (Figs. 8 to 14) are based on the volume of flow at inlet pressure and cover pipe sizes from ⅜ in. to 8 in. diameter. The top scales give the flow at pressure p_1 in terms of cubic feet per minute, cubic feet per second, and cubic feet per day. Since two pipe sizes are put on each chart, two velocity scales (one for each pipe size) are shown on the bottom scale. These velocities are likewise at pressure p_1. The long diagonal lines for each pipe size takes into account variation of the friction factor based on Reynold's number. In order to make it possible to use such a chart it is necessary to use kinematic viscosity since it combines two terms, absolute viscosity and density.

The 45° lines at the right of the chart correct for the kind and temperature of the gas. This factor is easiest taken into account by using the specific gravity at standard pressure and line temperature as referred to air (air = 1 at 60°F = 520°R). Figures 2 and 3 have been included to give these relative values. Figure 2 gives values for various gases and refrigerants. Figure 3 gives the value for steam. In order to facilitate the making of flow calculations, Fig. 5 gives the kinematic viscosities of several gases at atmospheric pressure plotted against temperatures. The kinematic viscosity at other pressures can be determined by multiplying 14.7 lb per sq in. and dividing by p_1.

Figure 4 gives the kinematic viscosity of steam for a wide range of conditions based on data by Hawkins, Potter, and Solberg. By use of Figs. 4 and 5 the required values for most calculations can be readily determined.

Figure 6 has been included to make it possible to convert viscosity data in centipoises and centistokes to pound per foot-second and square feet per second, respectively.

The pipe sizes included on the charts are for standard commercial steel pipe. The sizes also correspond to ASA Schedule 40 pipe. For other pipe sizes the approximate pressure drop can be found by multiplying the pressure drop by the ratio of actual diameter to the fifth power and dividing by the diameter for which the chart was constructed to the fifth power. This will not quite be correct since the variation is to some power slightly less than 5. The exact value depends on the pipe roughness and the value of the Reynold's number.

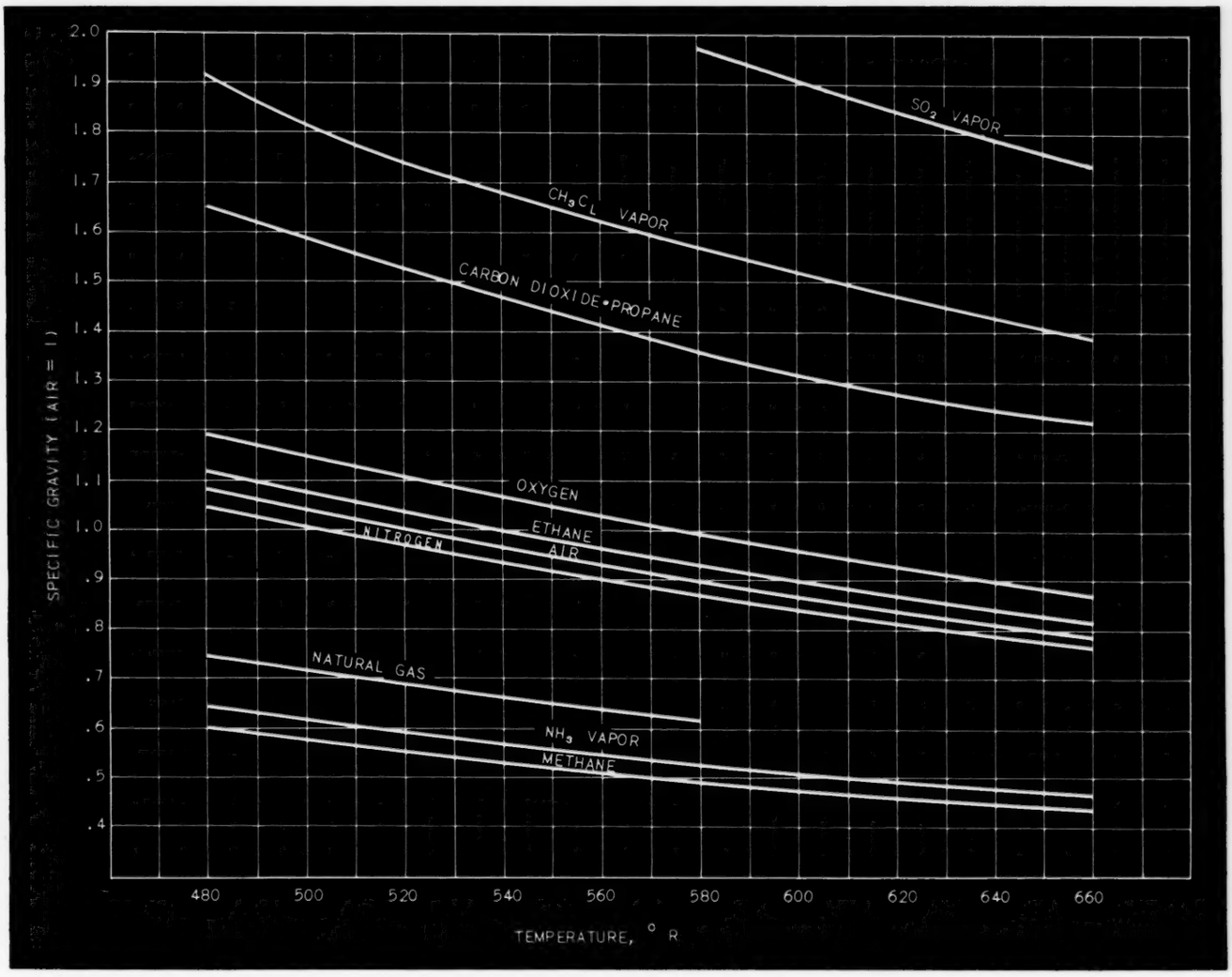

Fig. 2. Specific gravity of various gases including refrigerants.

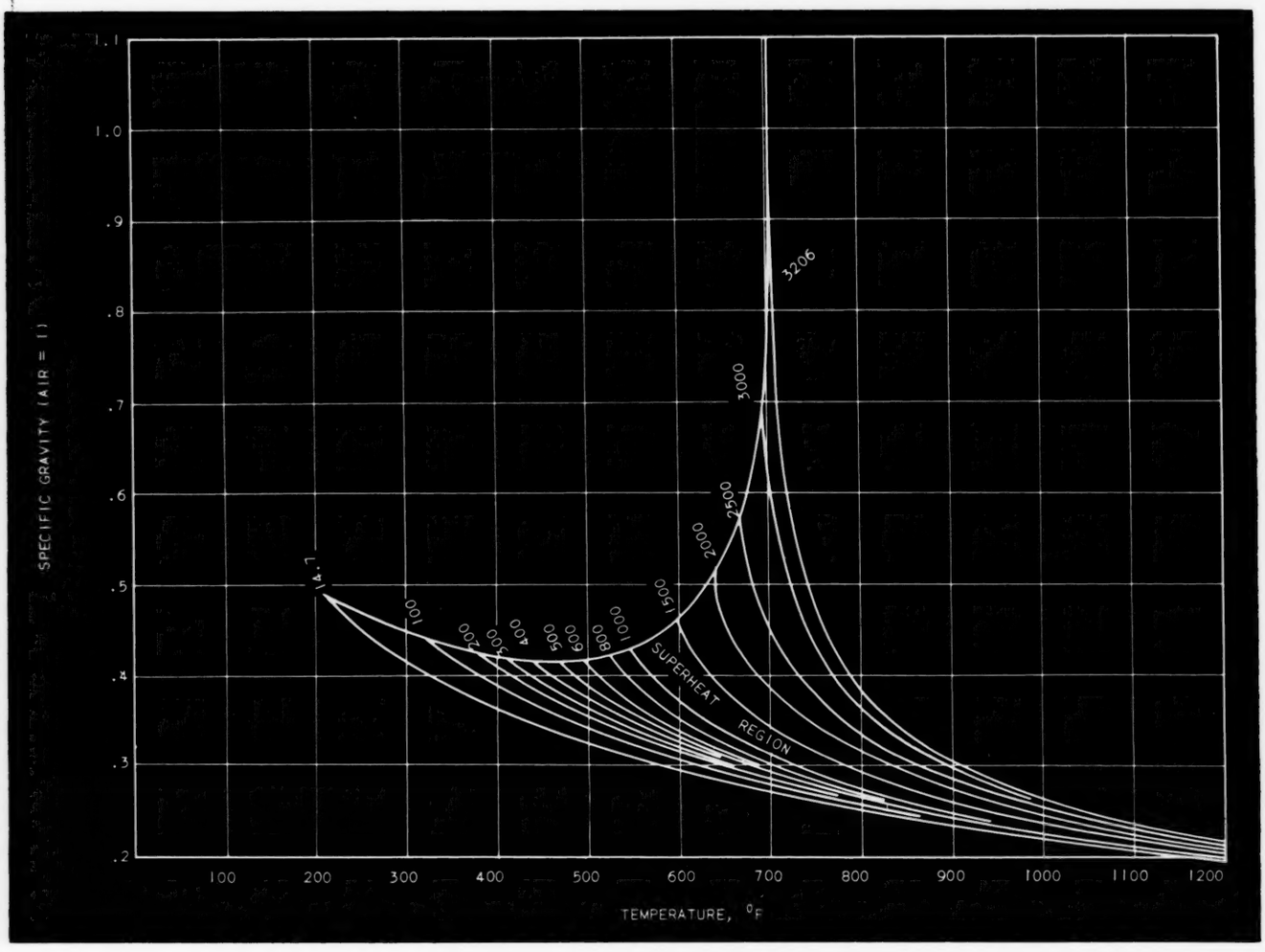

Fig. 3. Specific gravity of steam.

STEP-BY-STEP GUIDE

Following is a step-by-step set of instructions for use of these charts for the calculation of pressure drop of compressible fluids when the flow is isothermal.

(1) Determine the volume of flow in cubic feet per second, minute, or day at pressure p_1 or the velocity at the same pressure. If any one of these is known the others may be found from the chart.

(2) Determine the kinematic viscosity of the fluid at pressure p_1. The kinematic viscosity for steam at line pressure can be found from Fig. 4. The kinematic viscosity of other gases at line pressure can be found by multiplying the value from Fig. 5 by $14.7/p_1$.

(3) Enter the chart at the known value of volume rate of flow or velocity as found in (1), and trace to the kinematic viscosity, then right to the specific gravity of the fluid with respect to air at atmospheric pressure and pipe temperature, then parallel to the diagonal lines on the right-hand scale with key at top.

(4) Multiply the value from this upper scale by the length of pipe divided by 1000 and find

$$\frac{p_1 - p_2}{p_1} = \frac{p_1 - p_2}{p_1} \text{ for 1000 ft from chart} \times \frac{\text{length in feet}}{1000};$$

(5) Enter Fig. 1 at scale marked $\frac{p_1 - p_2}{p_1}$ calculated, trace to curve, then across to other scale and read $\frac{p_1 - p_2}{p_1}$ actual;

(6) $p_1 - p_2 = \frac{p_1 - p_2}{p_1}$ actual $\times p_1$

EXAMPLE AND SOLUTION

Example: Consider the case where 7 cubic feet per minute of methane at a pressure of 100 lb per sq in. absolute, having a specific gravity of 0.55 as compared with air, is flowing in a 1 in. standard pipe at a temperature of 40F or 500 R. If the pipe is 5000 feet long, what is the pressure drop?

Solution: From Fig. 5 the kinematic viscosity μ at 14.7 lb per sq in. abs. and 500 R is found to be 15.6×10^{-5} sq ft per sec at 14.7 lb per sq in. abs. The kinematic viscosity at 100 lb per sq in. absolute and the same temperature will be

$$\mu_{100} = 15.6 \times 10^{-5} \times \frac{14.7}{100} = 2.3 \times 10^{-5}$$

sq ft per sec. To find the pressure drop enter the chart for 1 in. pipe (Fig. 9) at 7 cubic feet per minute, trace down to a kinematic viscosity of 2.3×10^{-5} as indicated. Then trace right to the specific gravity line

NO. 9 OF A SERIES

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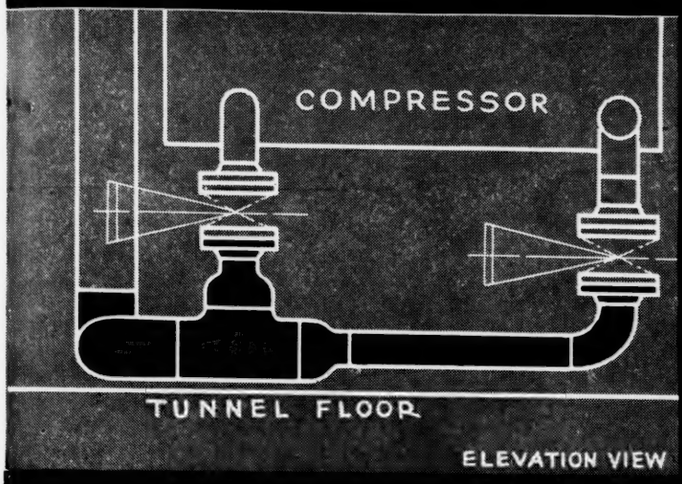
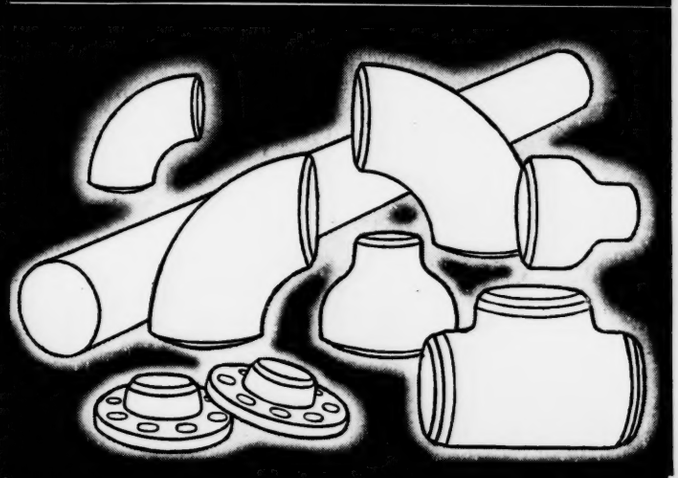
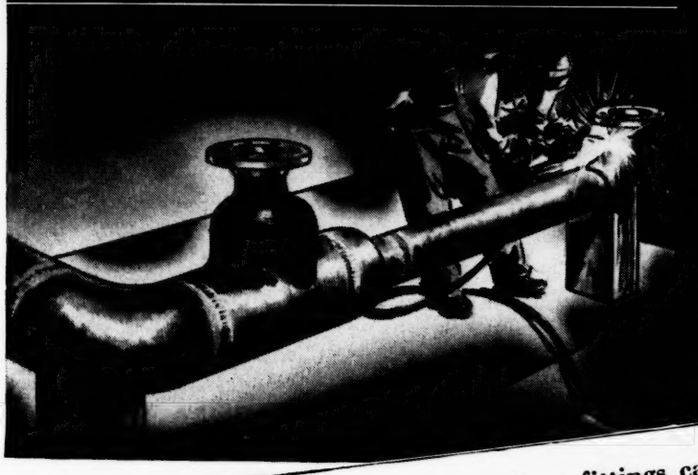
PROBLEM: Install Section of Piping into System

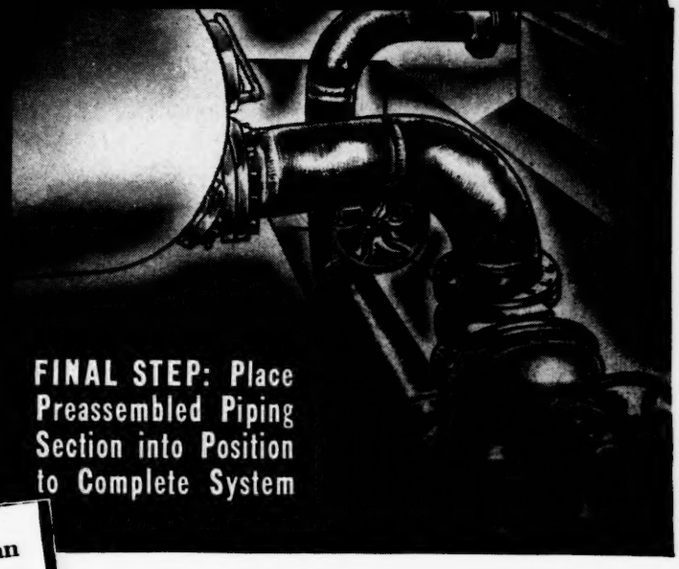


1st STEP: Assemble Pipe and Tube-Turn Fittings



2nd STEP: Preassemble Section in the Shop





FINAL STEP: Place Preassembled Piping Section into Position to Complete System

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of 0.55 and from there parallel to the diagonal lines and read on the right-hand scale $\frac{p_1 - p_2}{p_1}$ for 1000 ft of pipe equal to 0.035.

$$\frac{p_1 - p_2}{p_1} \text{ calculated} = 0.035 \times \frac{5000}{1000} = 0.175$$

Knowing that $\frac{p_1 - p_2}{p_1}$ calculated = 0.175, from Fig. 1 we can find that

$$\frac{p_1 - p_2}{p_1} \text{ actual} = 0.19$$

$p_1 - p_2 = 0.19$; $p_1 = 19$ lb per sq in. $p_2 = 100 - 19 = 81$ lb per sq in.

For normal lines where the pressure drop is small, Fig. 1 does not need to be used. For values of $\frac{p_1 - p_2}{p_1}$ of 0.175 the error introduced by not using Fig. 1 is about 10%. At values of $\frac{p_1 - p_2}{p_1}$ of 0.10, the error in neglecting to use Fig. 1 is 5%. If, for example, the above line had been 500 feet long then

$$\frac{p_1 - p_2}{p_1} = \frac{0.035 \times 500}{1000} = 0.0175$$

$p_1 - p_2 = 1.75$ lb per sq in.

As indicated previously the charts serve very conveniently for the making of conversions. For example, in the above example the flow of 7 cubic feet per minute corresponds to 0.12 cubic feet per second and 1000 cubic feet per day at pressure p_1 or 100 lb per sq in. The volume at atmospheric pressure will be the volume at pressure $p_1 \times \frac{p_1}{14.7}$. The velocity for a flow of 7 cubic feet per minute in 1 inch pipe will be 19.5 ft per sec. At the same flow rate the velocity in a ¾-in. pipe is seen to be 27 ft per sec.

When the specific gravity of the gas as compared with air exceeds 1 it is necessary to find the value of $\frac{p_1 - p_2}{p_1}$ for 1000 feet of pipe for specific gravity of 1 and multiply it by the specific gravity.

STEAM FLOW PROBLEMS

The following example illustrates the use of the charts for the solution of steam flow problems.

Example: Assume that 225 pounds of steam at a pressure of 300 lb per sq in. and 500F flows through a 4 in. standard pipe.

Solution: From Fig. 4 the kinematic viscosity $\mu = 2.5 \times 10^{-5}$. Since the specific volume of steam at 300 lb per sq in. and 500°F is 1.7675 cu ft per lb the volume of flow will be $225 \times 1.7675 = 400$ cubic feet per minute. Tracing from a flow rate of 400 cfm (Fig. 12) to 2.5×10^{-5} ft² per sec and over gives $\frac{p_1 - p_2}{p_1}$ for 1000 ft of pipe = 0.15. From Fig 3 the specific gravity is 0.37. Then, $\frac{p_1 - p_2}{p_1}$

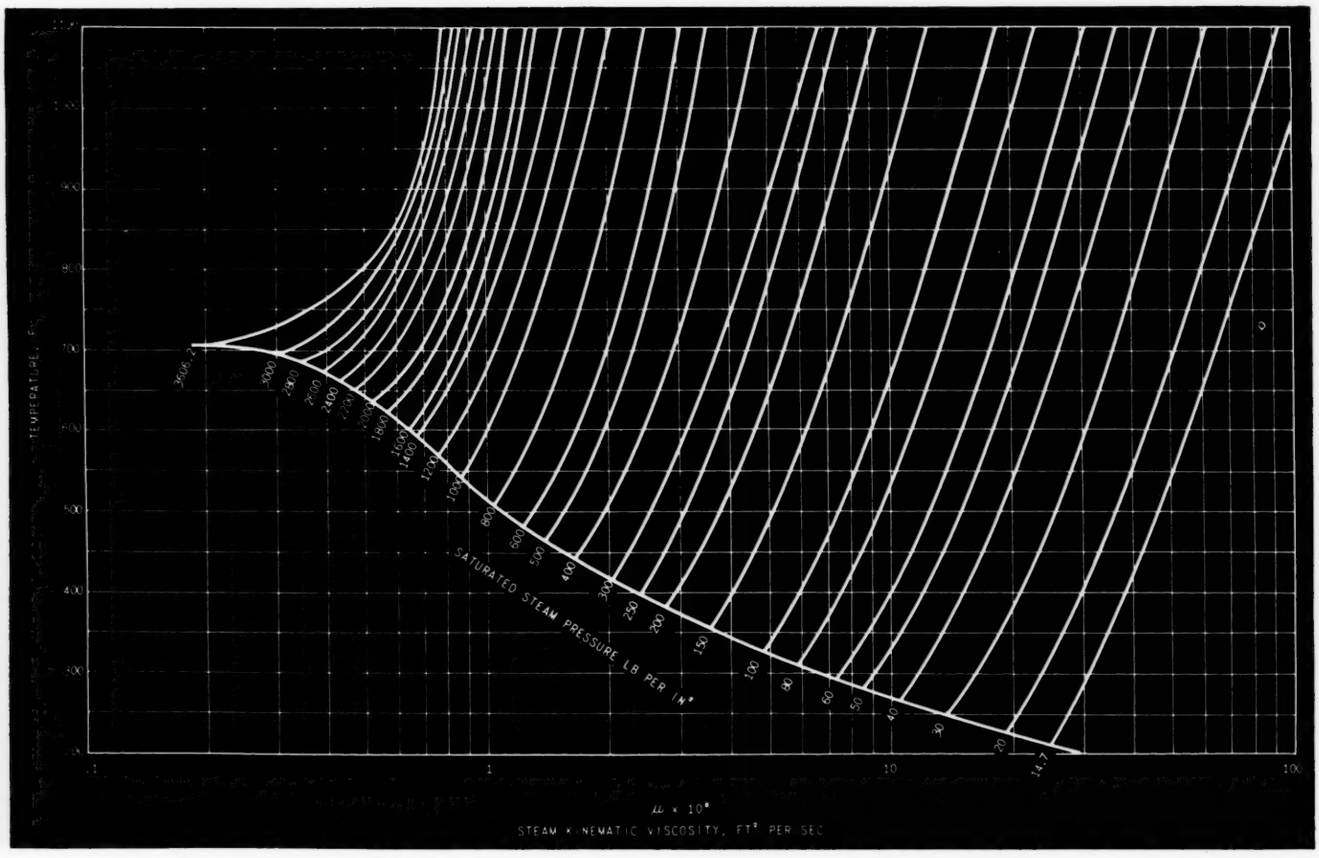

Fig. 4. Kinematic viscosity of steam for a wide range of conditions.

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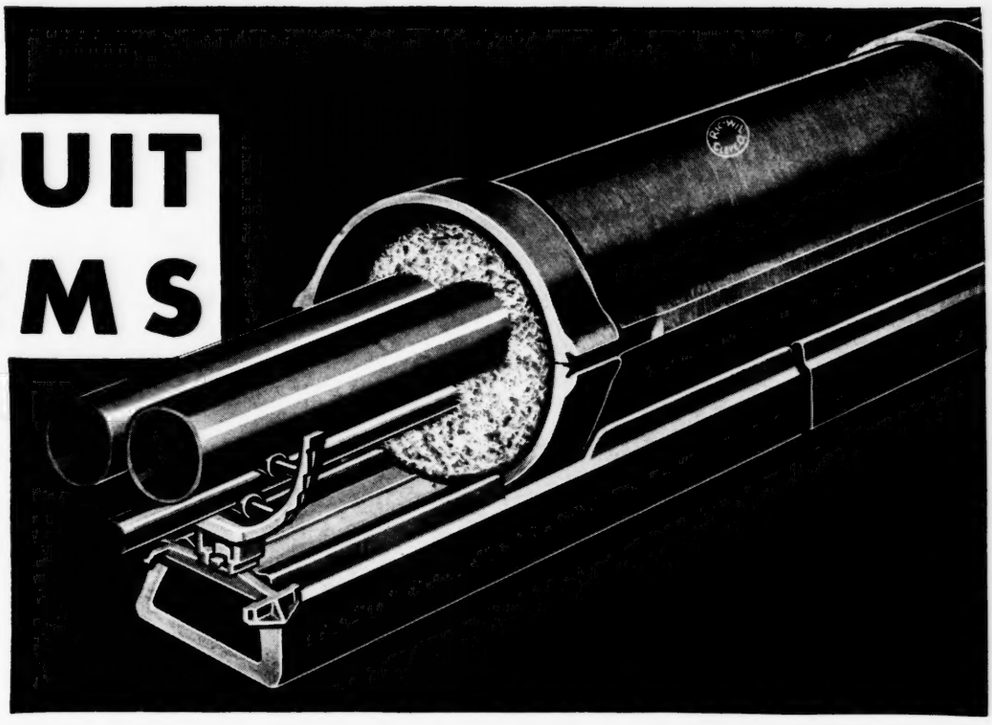

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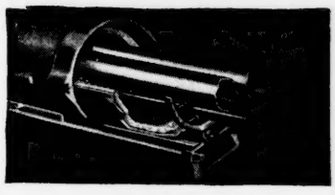

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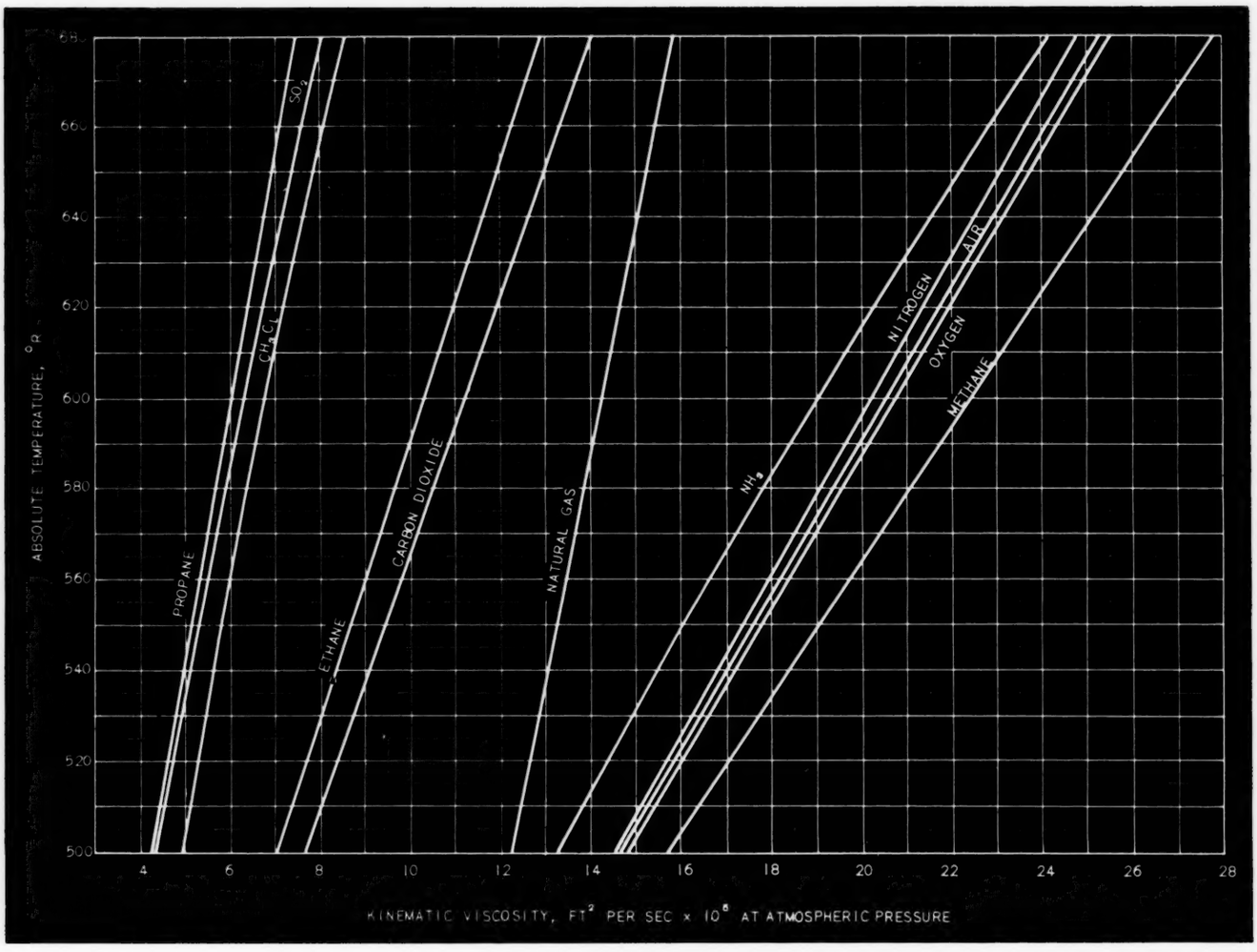

Fig. 5. Kinematic viscosities of various gases.

for 400 ft of pipe $= 0.15 \times \frac{400}{1000} \times$ 0.37 $= .0222$; $p_1 - p_2 = 300 \times .0222 = 6.66$ lb per sq in. Since the pressure drop rate is low, Fig. 1 did not need to be used.

PRESSURE DROP GIVEN

The foregoing examples showed how the charts can be applied to the determination of pressure drop for a given volume of flow. They can also be applied to the more difficult problem of finding the volume of flow for a given allowable pressure drop. The article previously mentioned showed how the velocity number could be applied to find the friction factor for this case. Here again the charts offer a much easier method. The procedure in the use of the charts for determination of the volume of flow corresponding to a given allowable pressure drop is as follows:

(1) Find $\frac{p_1 - p_2}{p_1}$;

(2) Enter Fig. 1 at scale marked correct value of $\frac{p_1 - p_2}{p_1}$, trace to conversion scale, then trace down and read calculated value of $\frac{p_1 - p_2}{p_1}$;

(3) Find $\frac{p_1 - p_2}{p_1}$ per 1000 ft of pipe;

$\frac{p_1 - p_2}{p_1}$ per 1000 ft of pipe $= \frac{p_1 - p_2}{p_1}$ calculated $\times \frac{1000}{\text{feet of pipe}}$;

(4) Enter right scale of Figs. 8-12 at value of $\frac{p_1 - p_2}{p_1}$ per 1000 feet of pipe, trace diagonally to value of specific gravity, then across to value of kinematic viscosity, then vertically and read volume rate of flow or velocity as desired. This method can best be illustrated by the following numerical example.

Example: It is desired to know the flow which will take place through 500 feet of 2½ inch steel pipe when $p_1 = 200$ lb per sq in., $p_2 = 160$ lb per sq in. The fluid is air at a temperature of 550F absolute having a specific gravity of 0.945.

Solution: From Fig. 5, $\mu = 17.5 \times 10^{-6} \times \frac{14.7}{200} = 1.29 \times 10^{-5}$ sq ft per sec.

(1) $\frac{p_1 - p_2}{p_1} = \frac{200 - 160}{200} = 0.20$;

(2) From Fig. 1, $\frac{p_1 - p_2}{p_1}$ calculated is 0.188;

(3) $\frac{p_1 - p_2}{p_1}$ per 1000 ft of pipe $= 0.188 \times \frac{1000}{500} = 0.376$;

(4) Enter Fig. 11 on right scale of 0.376, trace diagonally to specific gravity = 0.945 as indicated by the

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arrow, then across to $\mu = 1.29 \times 10^{-5}$. From this line trace to the top scale and read the rate of flow to be 3.1 cubic feet per sec, 190 cubic ft per min or 27,000 cubic ft per day. The velocity can be found on the bottom scale to be 93 ft per sec at the pipe inlet. The velocity at the pipe outlet can be found from the relation $v_2 = v_1 \times \frac{p_1}{p_2} = 93 \times \frac{200}{160}$ = 116 ft per sec.

ACCURACY OF CHARTS

There is frequently some objection to the use of charts such as those given here for the solution of flow problems on the ground that they are not so accurate as slide rule or machine calculations. It would also appear from casual inspection that the range of viscosities are such that accurate values cannot be selected on the chart. Practically, considerable error is frequently introduced because of the complicated nature of formulas, so that even though the value from any one chart cannot be read as accurately as might be hoped for, the resulting answer will in many cases be as satisfactory as is normally experienced with slide rule calculations unless extreme care is taken or computing machines are used for obtaining the result.

There are several practical factors that must be taken into consideration when considering the accuracy of calculation of pressure drop regardless of the method used. The first of these is the exact value of the diameter. Because of the tolerances allowed in the manufacture of tubular goods all pipe will not be ex-

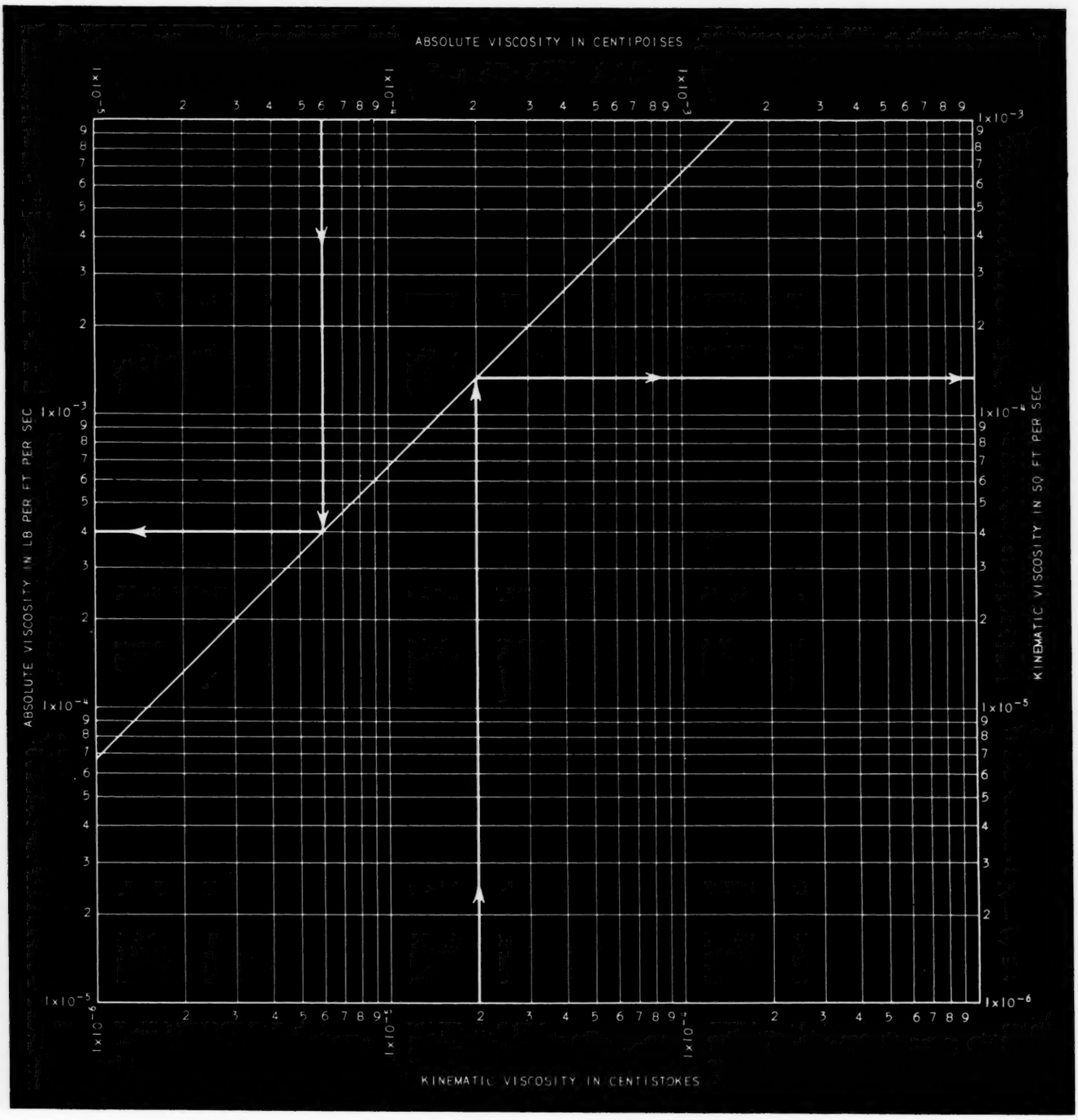
ABSOLUTE VISCOSITY IN CENTIPOISES
ABSOLUTE VISCOSITY IN LB PER FT PER SEC
KINEMATIC VISCOSITY IN SQ FT PER SEC
KINEMATIC VISCOSITY IN CENTISTOKES

Fig. 6. Chart for converting viscosity data in centipoises and centistokes to pound per foot second and square feet per second respectively.

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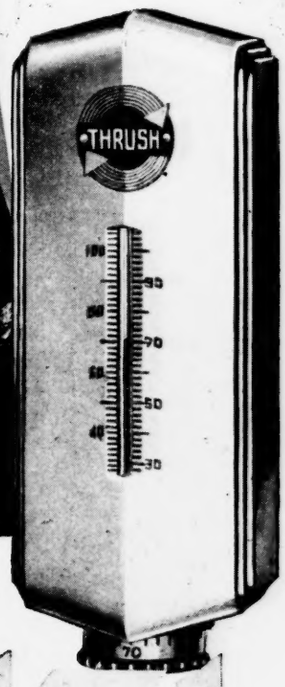

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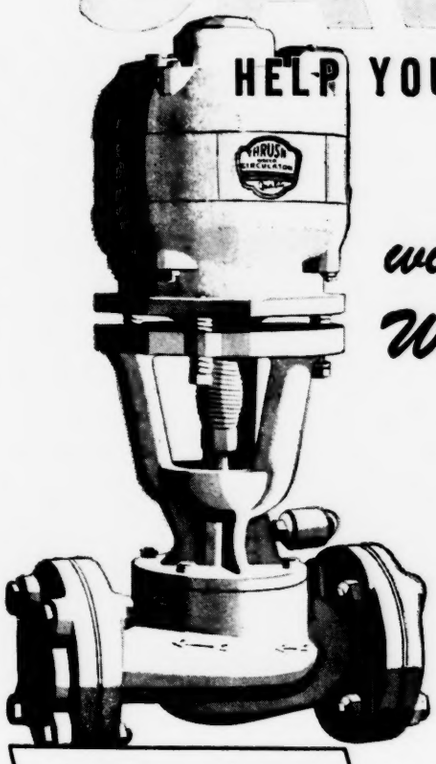

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actly the same size. Inasmuch as the pressure drop varies approximately as the fifth power of the diameter, a very small error in the correct diameter will make a large difference in the pressure drop. For example, a 1% variation in diameter will mean approximately a 5% variation in the pressure drop. Since the tolerance on ordinary pipe is considerable, it cannot normally be expected that the actual inside diameter of the pipe will be known with an accuracy greater than 2 or 3%, particularly on the small sizes. Consequently, in many cases the pressure drop calculation will vary as much as 10 to 15% from the predicted value because of variation in diameter alone. This variation is normally blamed on the variation in the friction factor. Actually, the friction factor can be selected much more accurately for any normal type of **new** product than the diameter can be determined, and variation in pressure drop from the calculated values will often be found to be the result of variation in diameter rather than error in selection of friction factor. Inasmuch as the diameter value is normally taken out of a table which gives nominal sizes, it is not rational to try to use extreme accuracy when even as much as 1% variation of the diameter from the value selected will change the pressure drop 5%.

The spread of the viscosity lines as shown in the charts is very small. The reason for this is that the viscosity in the case of turbulent flow which is normally encountered in the flow of vapors or gases is not directly dependent on the viscosity; rather it depends on the viscosity to some power less than the one-fifth power. The effect of viscosity can perhaps be seen by referring to the Figs. 1 and 2 of the article referred to in Footnote 1. At the low value of Reynold's number in the turbulent region, the friction factor curves are relatively steep and the viscosity will show its maximum effect. In this range the effect of varying the viscosity by a factor of 2 produces only a 14% change in the pressure drop. In the higher range of Reynold's number which is normally encountered in the flow of gases and vapors, the effect of viscosity is less pronounced. A variation of the viscosity by a factor of 2 produced only a 6% change in the pressure drop. The viscosities can, therefore, be interpolated on the chart with as great accuracy as the other calculations can be made. One advantage in the use of such charts is that they tend to put everything into its proper perspective. This is evidenced on the charts by the narrow band covered by a wide range of viscosity.

When very short pipes are used and the pressure drop is **high** the chart may not give the value. By use of an auxiliary sheet of log paper or by projection back on the same sheet, the values can be found.

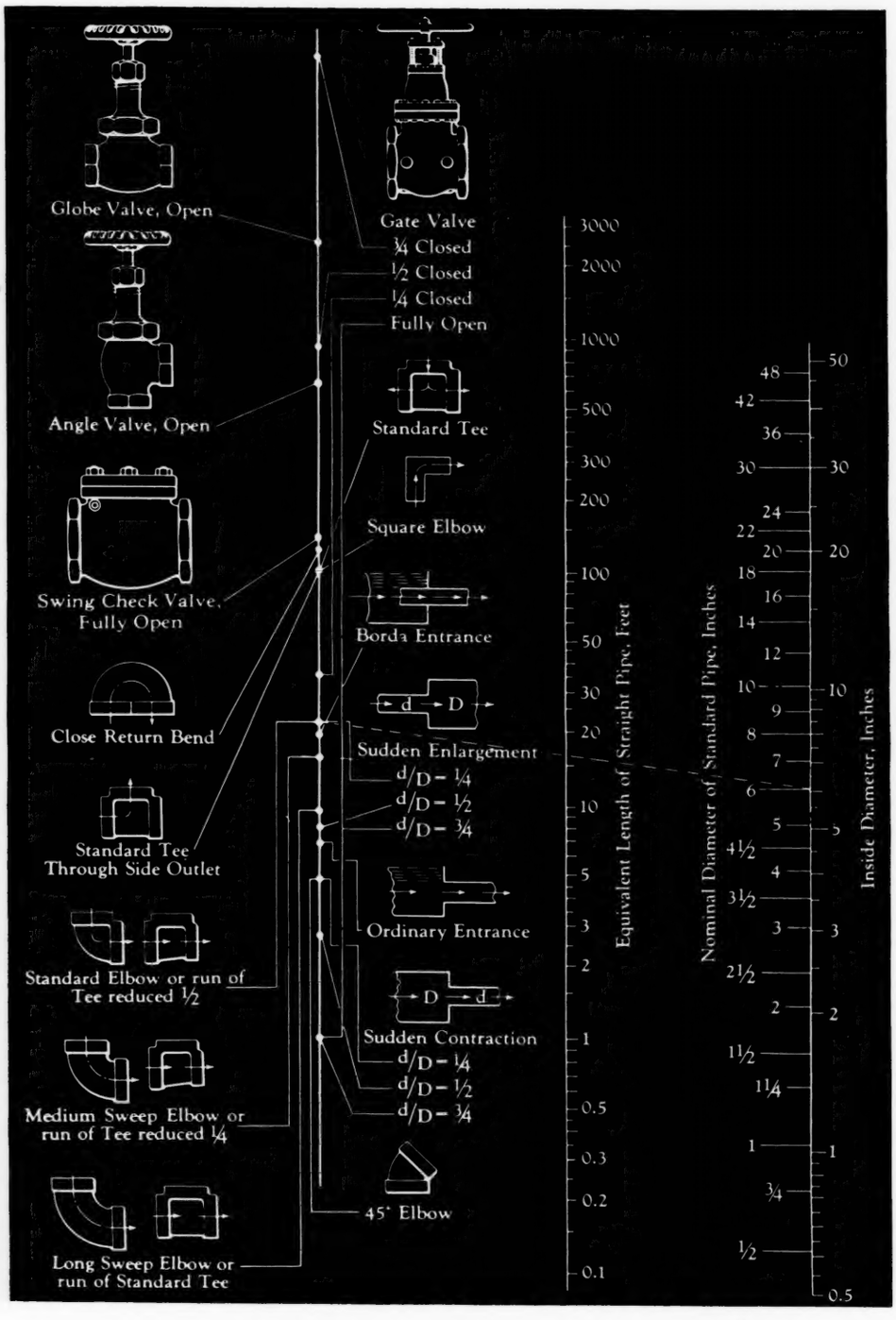
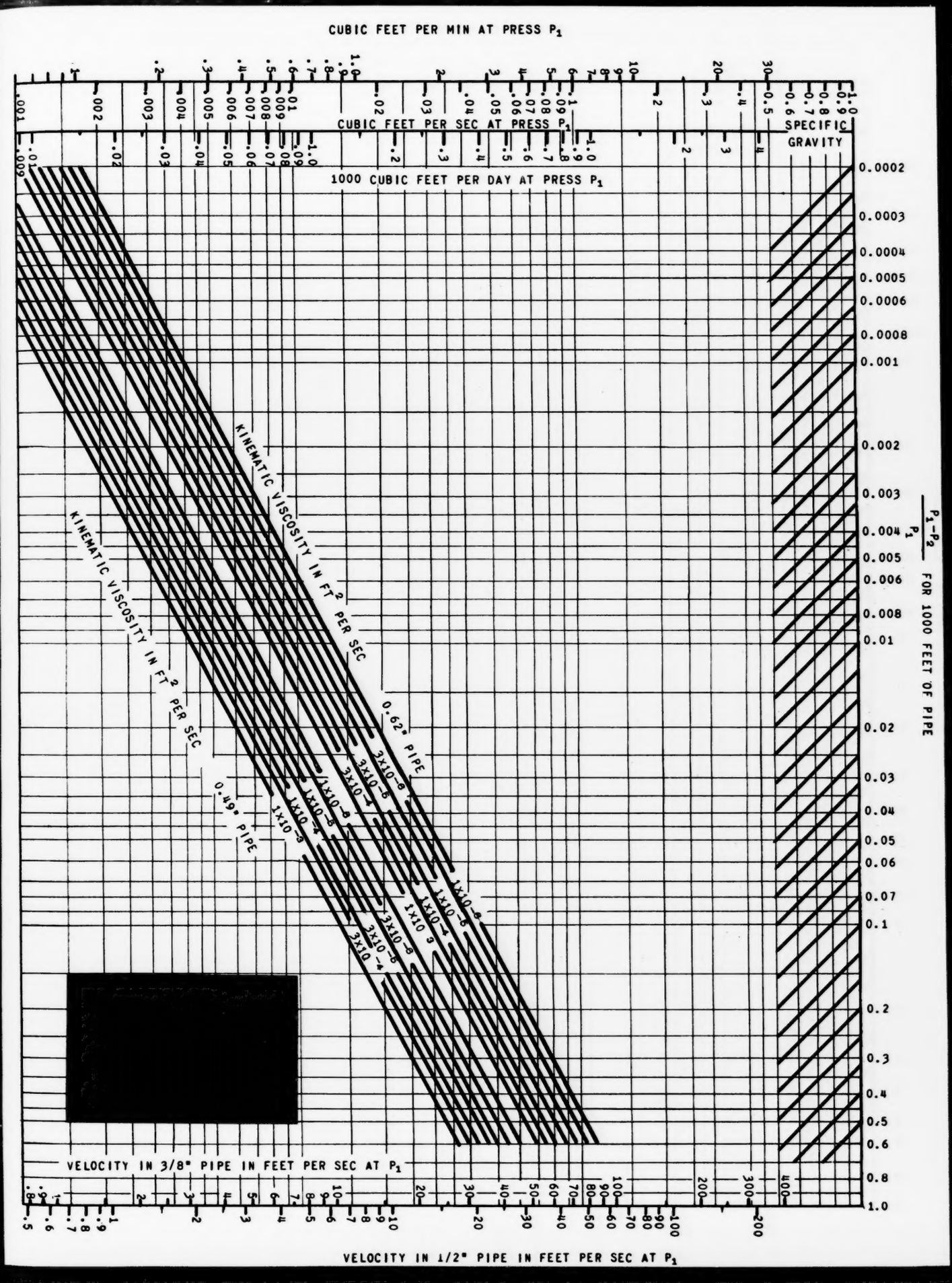
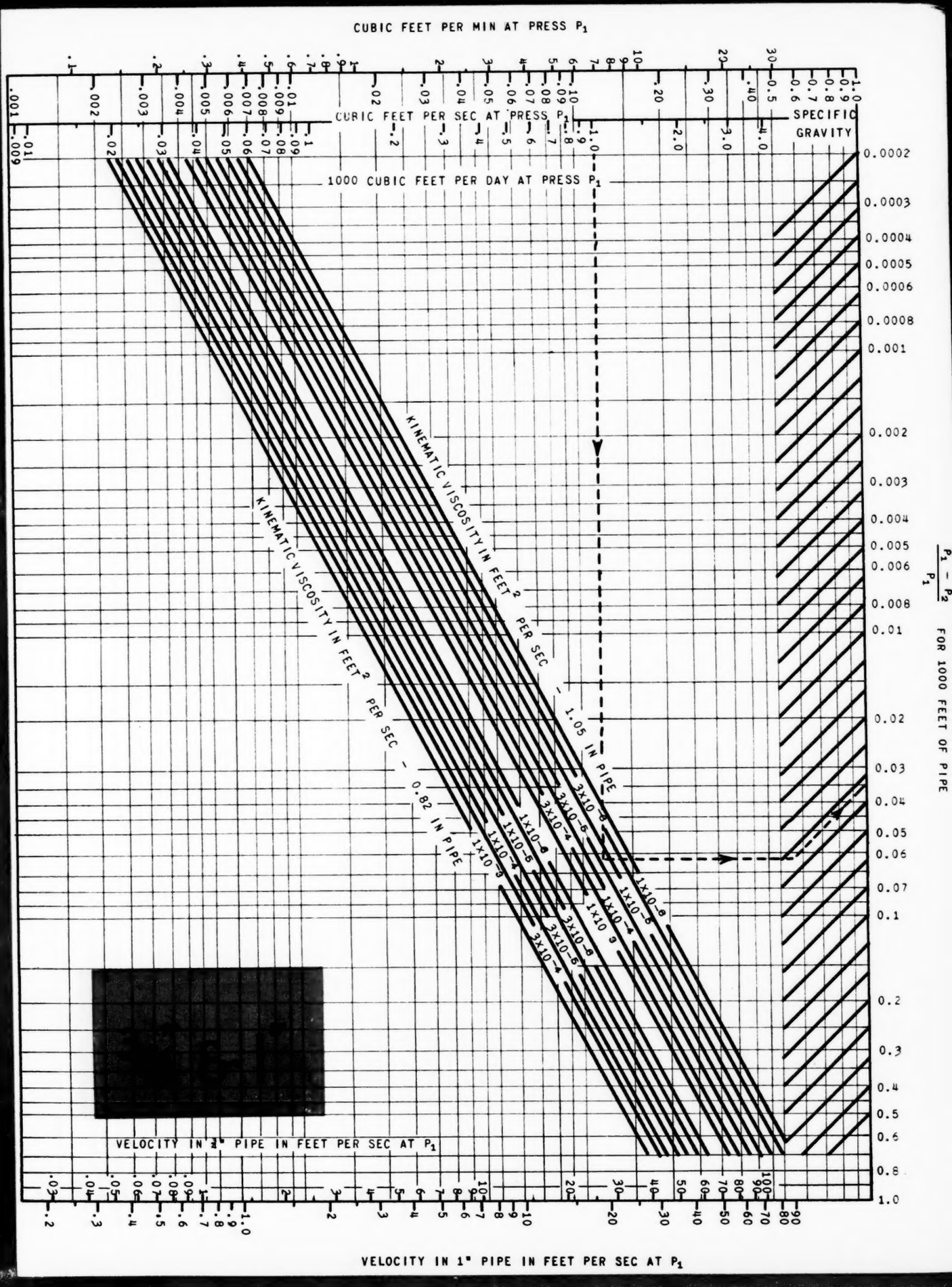
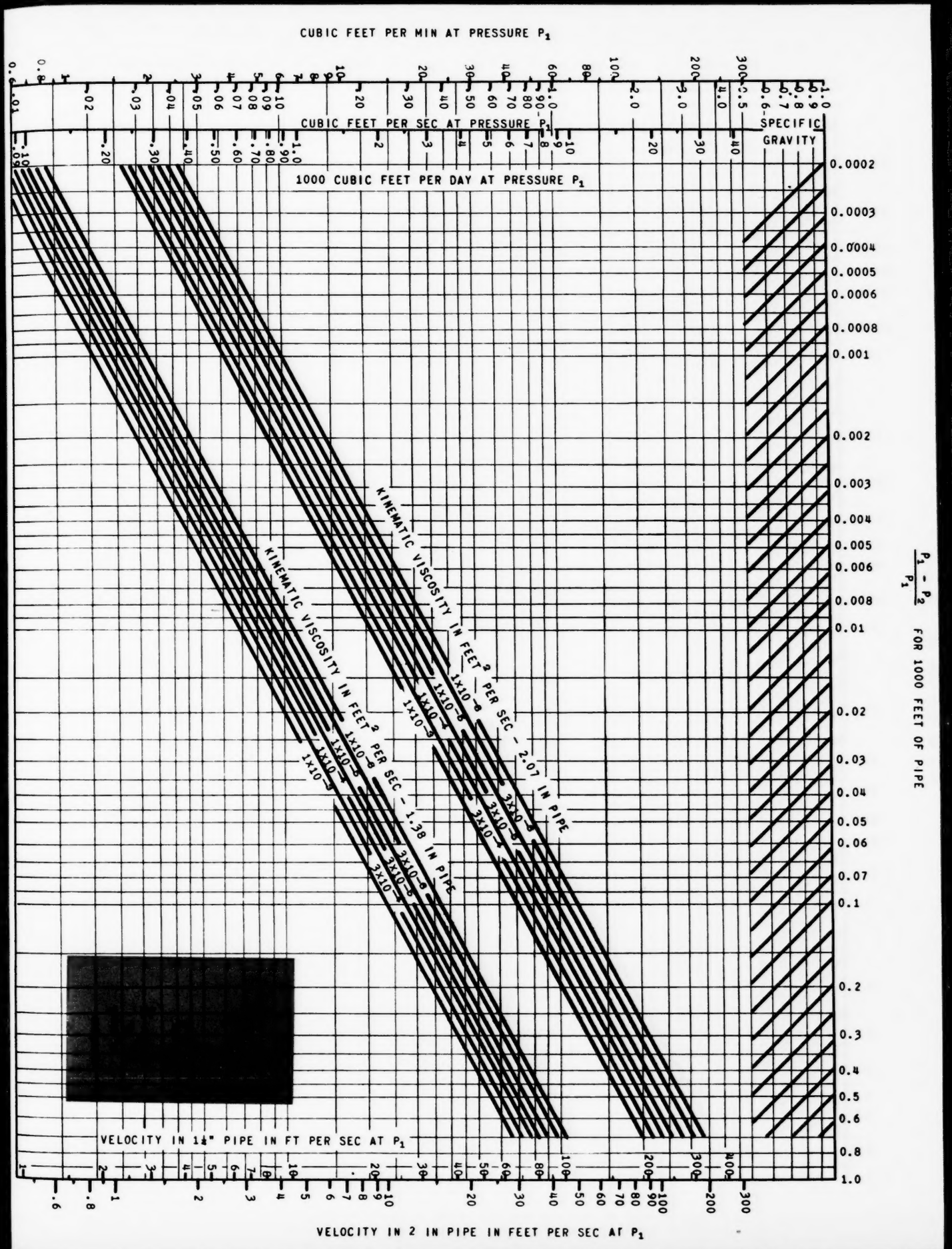


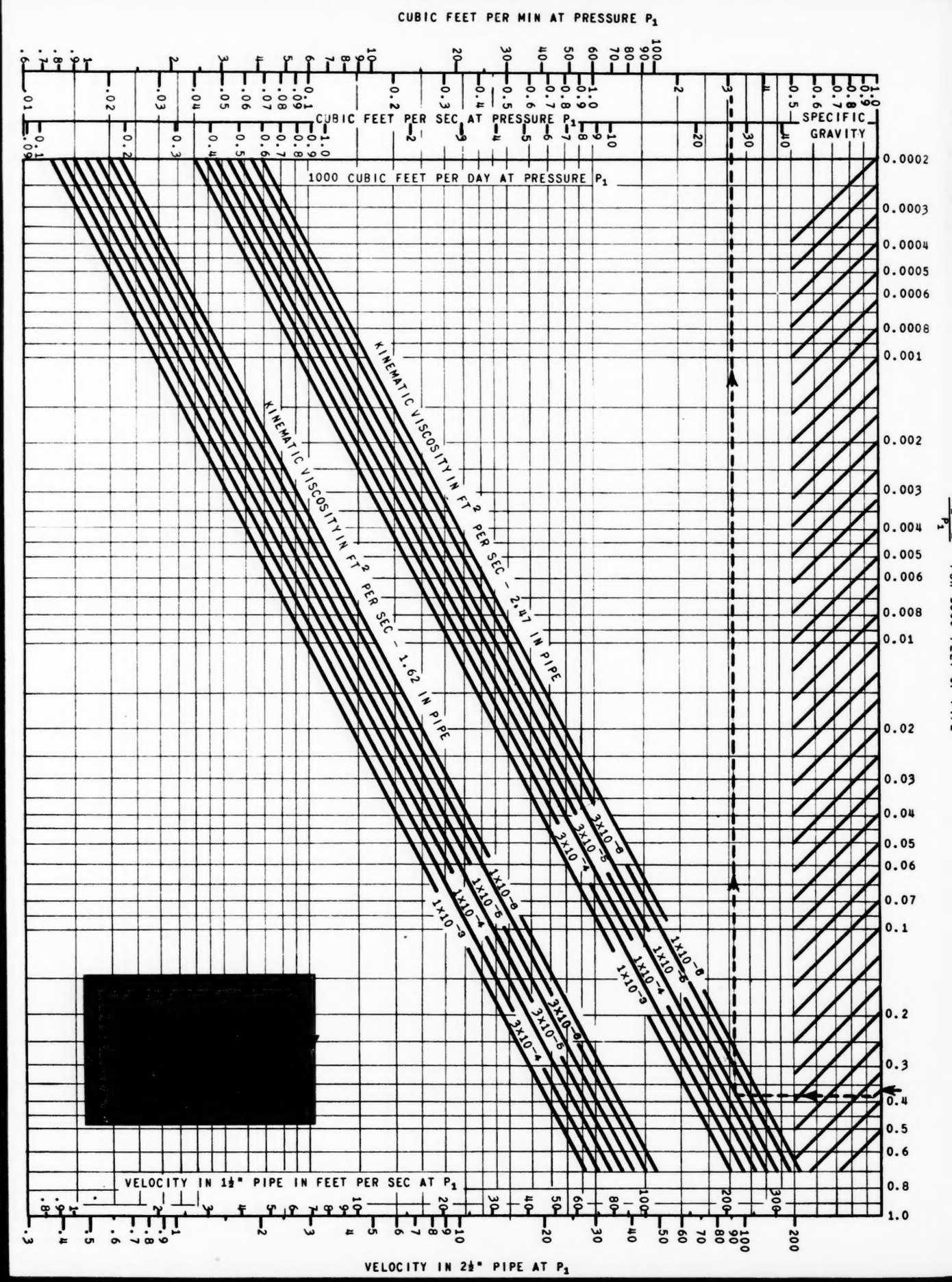
Fig. 7. Resistance of valves and fittings to flow of fluids. Chart courtesy of Crane Company.

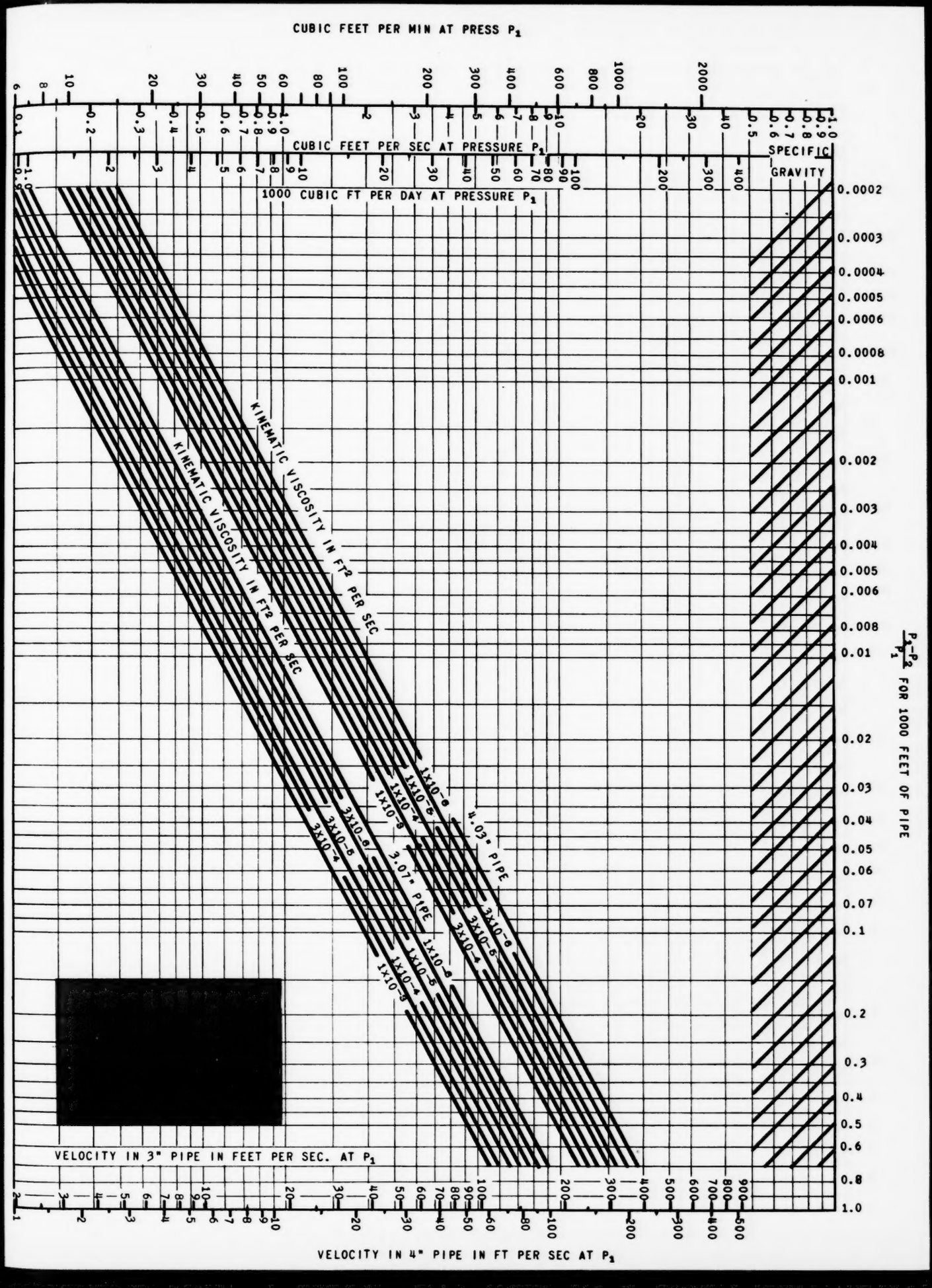
THE WORKING CHARTS (FIGS. 8-14) BEGIN ON THE OPPOSITE PAGE→ AND CONTINUE THROUGH TO PAGE 69, INCL.

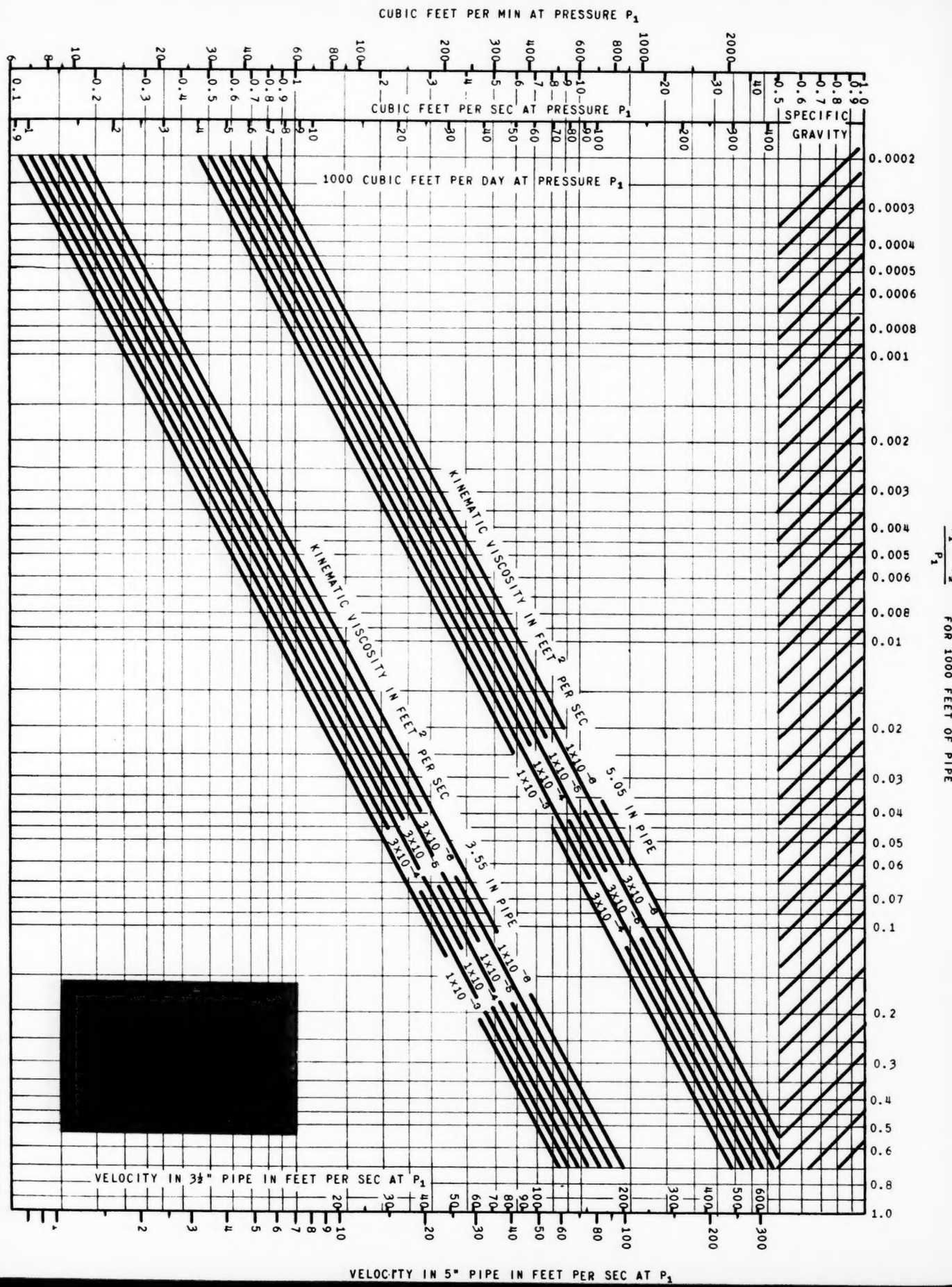

CUBIC FEET PER MIN AT PRESS P_1
CUBIC FEET PER SEC AT PRESS P_1
1000 CUBIC FEET PER DAY AT PRESS P_1
SPECIFIC GRAVITY
KINEMATIC VISCOSITY IN FT^2 PER SEC
KINEMATIC VISCOSITY IN FT^2 PER SEC
0.62" PIPE
0.49" PIPE
3×10^{-5}
3×10^{-4}
1×10^{-5}
1×10^{-4}
1×10^{-3}
3×10^{-5}
3×10^{-4}
1×10^{-5}
1×10^{-4}
1×10^{-3}
$\frac{P_1-P_2}{P_1}$ FOR 1000 FEET OF PIPE
VELOCITY IN 3/8" PIPE IN FEET PER SEC AT P_1
VELOCITY IN 1/2" PIPE IN FEET PER SEC AT P_1

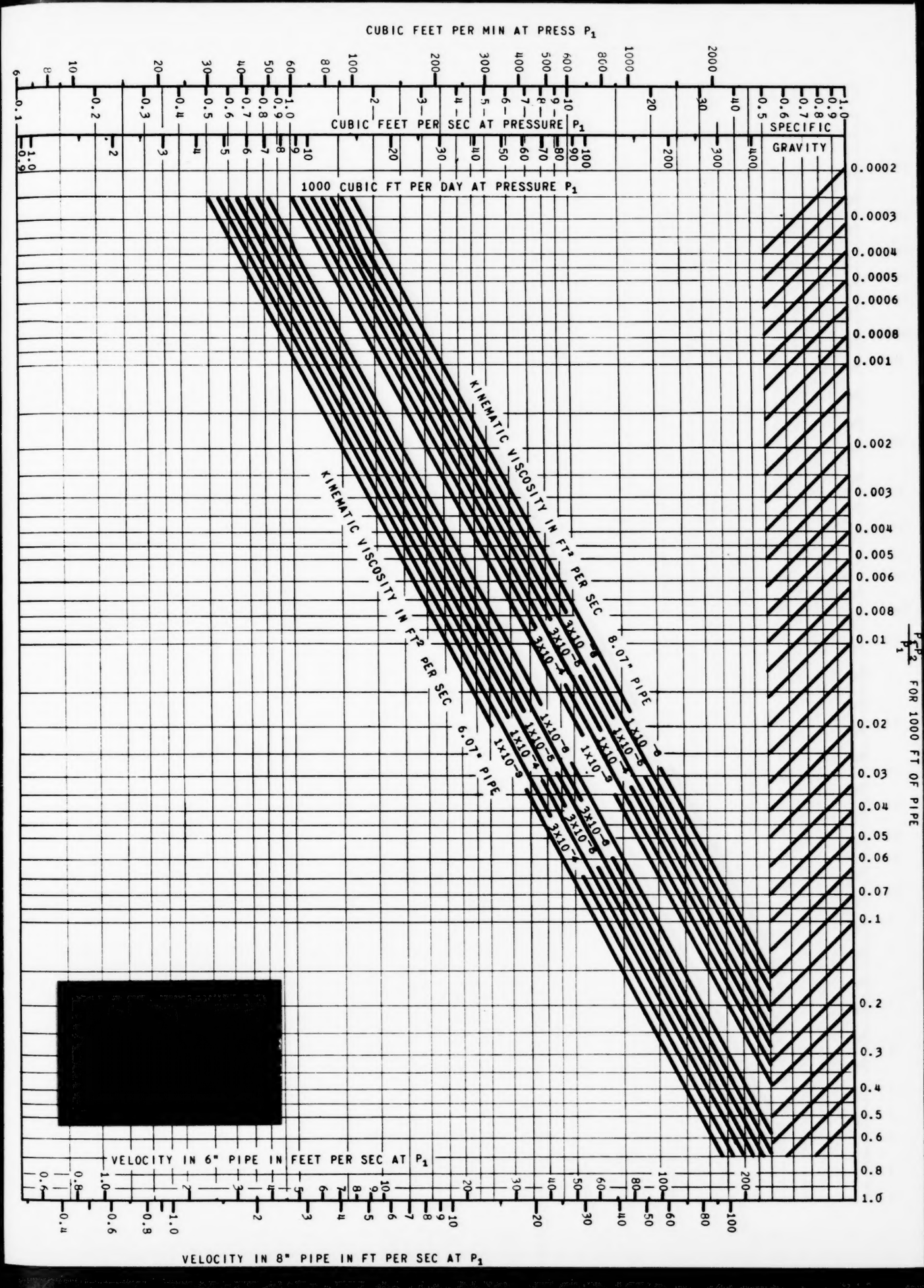

CUBIC FEET PER MIN AT PRESS P_1
CUBIC FEET PER SEC AT PRESS P_1
SPECIFIC GRAVITY
1000 CUBIC FEET PER DAY AT PRESS P_1
KINEMATIC VISCOSITY IN FEET^2 PER SEC - 1.05 IN PIPE
KINEMATIC VISCOSITY IN FEET^2 PER SEC - 0.82 IN PIPE
$\frac{P_1 - P_2}{P_1}$ FOR 1000 FEET OF PIPE
VELOCITY IN ½" PIPE IN FEET PER SEC AT P_1
VELOCITY IN 1" PIPE IN FEET PER SEC AT P_1


CUBIC FEET PER MIN AT PRESSURE P_1
CUBIC FEET PER SEC AT PRESSURE P_1
SPECIFIC GRAVITY
1000 CUBIC FEET PER DAY AT PRESSURE P_1
KINEMATIC VISCOSITY IN FEET² PER SEC - 2.07 IN PIPE
KINEMATIC VISCOSITY IN FEET² PER SEC - 1.38 IN PIPE
VELOCITY IN 1¼" PIPE IN FT PER SEC AT P_1
VELOCITY IN 2 IN PIPE IN FEET PER SEC AT P_1
$\frac{P_1 - P_2}{P_1}$ FOR 1000 FEET OF PIPE

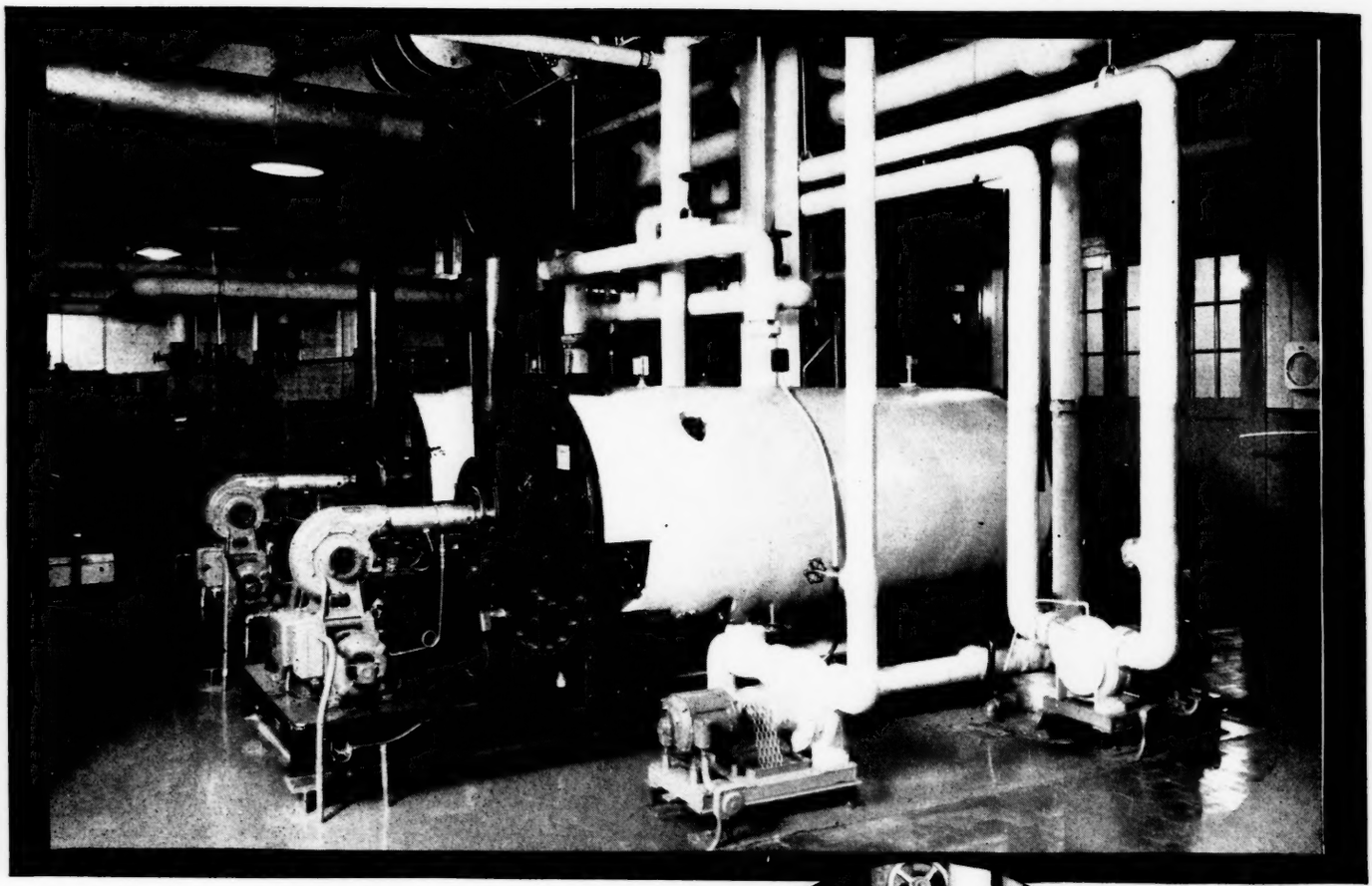

CUBIC FEET PER MIN AT PRESSURE P_1
CUBIC FEET PER SEC AT PRESSURE P_1
SPECIFIC GRAVITY
1000 CUBIC FEET PER DAY AT PRESSURE P_1
KINEMATIC VISCOSITY IN FT^2 PER SEC - 2.47 IN PIPE
KINEMATIC VISCOSITY IN FT^2 PER SEC - 1.62 IN PIPE
VELOCITY IN 1½" PIPE IN FEET PER SEC AT P_1
VELOCITY IN 2½" PIPE AT P_1
P_1

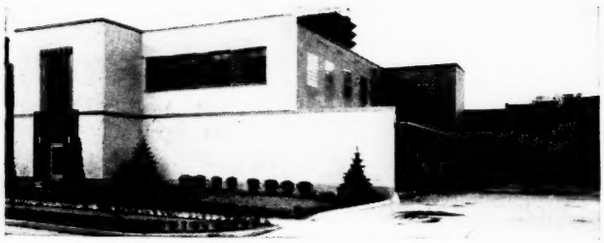

CUBIC FEET PER MIN AT PRESS P_1
CUBIC FEET PER SEC AT PRESSURE P_1
1000 CUBIC FT PER DAY AT PRESSURE P_1
SPECIFIC GRAVITY
0.0002
0.0003
0.0004
0.0005
0.0006
0.0008
0.001
0.002
0.003
0.004
0.005
0.006
0.008
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.1
0.2
0.3
0.4
0.5
0.6
0.8
1.0
KINEMATIC VISCOSITY IN FT^2 PER SEC
KINEMATIC VISCOSITY IN FT^2 PER SEC
1x10-6
1x10-5
1x10-4
1x10-3
3x10-6
3x10-5
3x10-4
4.03" PIPE
3.07" PIPE
VELOCITY IN 3" PIPE IN FEET PER SEC. AT P_1
VELOCITY IN 4" PIPE IN FT PER SEC AT P_1
$\frac{P_1-P_2}{P_1}$ FOR 1000 FEET OF PIPE
$\frac{P_1-P_2}{P_1}$ FOR 1000 FEET OF PIPE


CUBIC FEET PER MIN AT PRESSURE P_1
CUBIC FEET PER SEC AT PRESSURE P_1
SPECIFIC GRAVITY
1000 CUBIC FEET PER DAY AT PRESSURE P_1
KINEMATIC VISCOSITY IN FEET^2 PER SEC
1x10^{-3}
1x10^{-4}
1x10^{-5}
1x10^{-6}
5.05 IN PIPE
3.55 IN PIPE
3x10^{-3}
3x10^{-4}
3x10^{-5}
3x10^{-6}
VELOCITY IN 3½" PIPE IN FEET PER SEC AT P_1
VELOCITY IN 5" PIPE IN FEET PER SEC AT P_1
$\frac{\Delta}{P_1}$ = FOR 1000 FEET OF PIPE


CUBIC FEET PER MIN AT PRESS P_1
CUBIC FEET PER SEC AT PRESSURE P_1
SPECIFIC GRAVITY
1000 CUBIC FT PER DAY AT PRESSURE P_1
KINEMATIC VISCOSITY IN FT² PER SEC
8.07" PIPE
KINEMATIC VISCOSITY IN FT² PER SEC
6.07" PIPE
$\frac{P_1^2 - P_2^2}{P_1}$ FOR 1000 FT OF PIPE
VELOCITY IN 6" PIPE IN FEET PER SEC AT P_1
VELOCITY IN 8" PIPE IN FT PER SEC AT P_1

BOTH HEATING AND PROCESSING
BY B & G FORCED HOT WATER SYSTEM





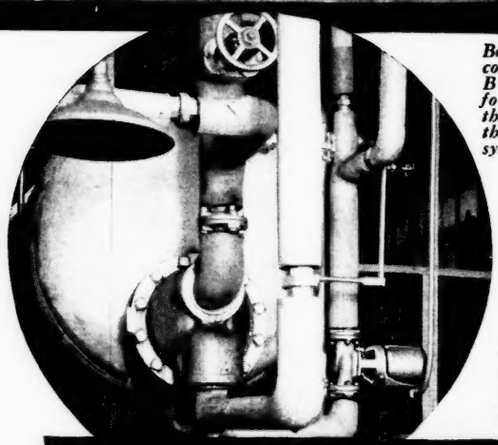
Growing use of forced hot water for combined space heating and process work is well illustrated by the B & G Monoflo System in this modern ice cream plant.

The system is ingeniously designed to do three distinct duties . . . heating the building . . . supplying hot water for pasteurizing milk and cream . . . and heating the service water. The service water load is very heavy, being used for general sterilization and for heating chocolate-melting kettles.

A hot water heated fin-coil conditioning unit furnishes heat to the main office, located directly above the sub-zero hardening room. Locker rooms, loading dock, offices, etc., are radiation heated. The desired temperature in various sections of the building is obtained by zoning.

Hot water for the pasteurizing vats is pumped directly from the boiler and returned by gravity. This eliminates the need for any intermediate heat transfer apparatus. Service water is furnished by an Indirect Heater, heated by water also pumped directly from the boiler.

Complete design data on the B & G Monoflo System is given in the B & G Handbook. Send for your copy.



Boiler room, showing cross-connected boilers and two B & G Universal Pumps for circulating water to the pasteurizing vats and through the service water system.

(In circle) Indirect Water Heater with B & G Booster for circulating hot water from the boiler to the heater.

Pasteurizing vats heated with water pumped directly from the boiler. Vats must be heated from 45° F. to 165° F. in not less than thirty minutes.

B & G MONOFLO SYSTEM

BELL & GOSSETT COMPANY MORTON GROVE, ILLINOIS (Suburb of Chicago)

Canadian Licensee: S. A. Armstrong, Ltd., 115 Dupont St., Toronto

How to Design Exhaust Hoods

By J. M. DALLA VALLE

Engineer and Consultant,
Kruse Engineering Co.,
Newark, N. J.

Part 8—Hoods for Control of Fumes, Mists, Vapors, and Gases

OPENINGS used for the control of fumes, mists, vapors, and gases are best classified according to their application. There are three broad groups. By far the greatest application of hoods for the collection of the above-mentioned substances is over tanks. In this group are two types, the lateral or slot exhaust, and the canopy or overhead hood.

A second group, restricted chiefly to the canopy type, has for its object the removal of smoke, gases, or fumes from heated sources. These hoods, as a rule, are large and cover considerable area.

Finally, the third group includes booth-like structures similar to those used for spray painting. Total enclosures are sometimes used (as in the case of some types of degreaser and electroplating tanks), but this is not common practice. Removable covers are frequently used in this connection.

Exhaust Ventilation from Tanks

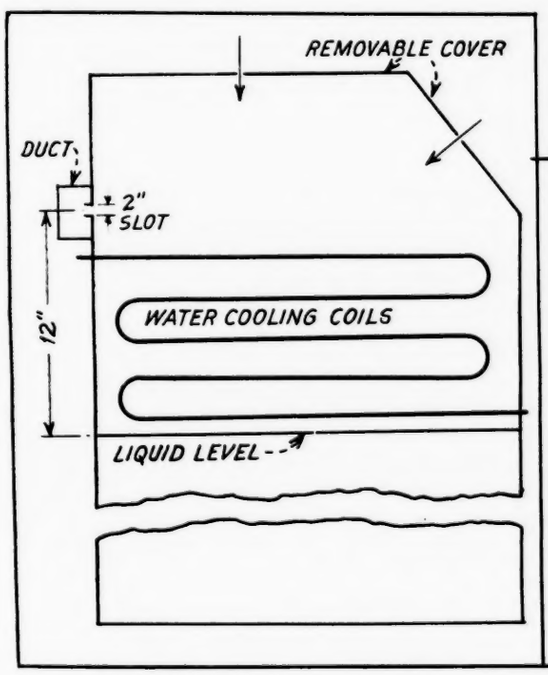
Two types of exhaust ventilation are used with tanks. These are (1) the so-called lateral exhaust, and (2) the overhead type, described on previous pages. The lateral type of exhaust is used with relatively narrow tanks, and consists of a narrow slot usually extending around the periphery of the tank, or along the mid-section (with two lateral openings). Lateral exhaust is used with narrow tanks. It offers little interference to work being carried on, but its effectiveness is limited to short distances within the tank. The characteristics of this type of opening were discussed in Part 3. The second type is used for operations where no interference is encountered by placing the hood over the tank. Such hoods take advantage of the normal tendency of many vapors to rise (steam, etc.) and are useful when the tanks are large in area.

Exhaust ventilation used with tanks may be aided by tank covers with narrow slots which direct the air flow across the tank surface to the duct. Heavier-than-air vapors are best controlled with the lateral type exhaust.

Exhaust duct velocities should be kept at values ranging from 1500 to 2000 feet per minute. Opening velocities for overhead tanks are determined by Equation 13:

$$Q = 1.4\ P \times D \times V$$

Degreasing. Degreasers utilize fluids which give off heavier-than-air vapors. For this reason it is preferable to use lateral type exhausts. Because of the cost of the degreaser fluids, ventilation must often be reduced to restrict excessive evaporation. This last-mentioned factor can be reduced by using condensing coils (cold water) about the inner edge of the tank, in the manner indicated in Fig. 61. A 10- to 12-inch coil depth is sufficient, extending from the edge of the tank proper to the liquid surface.



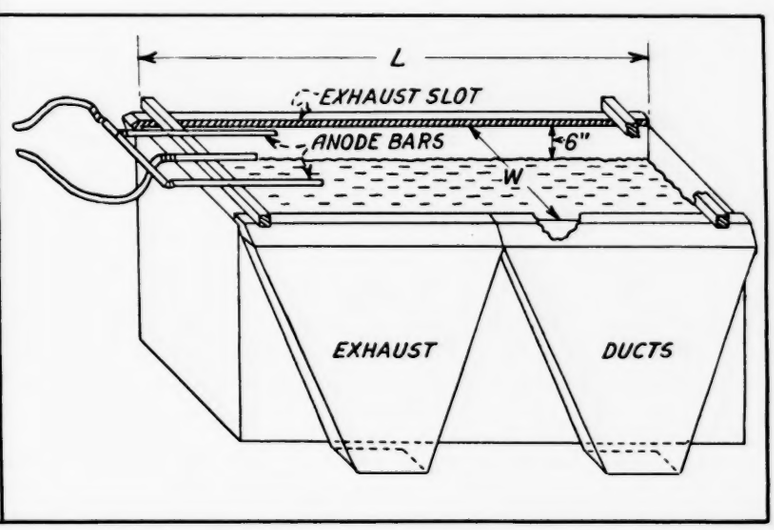


Fig. 61 (Left) Slot arrangement and cooling coils for degreaser. Fig. 62 (Below) Lateral slots for chrome plating tank.

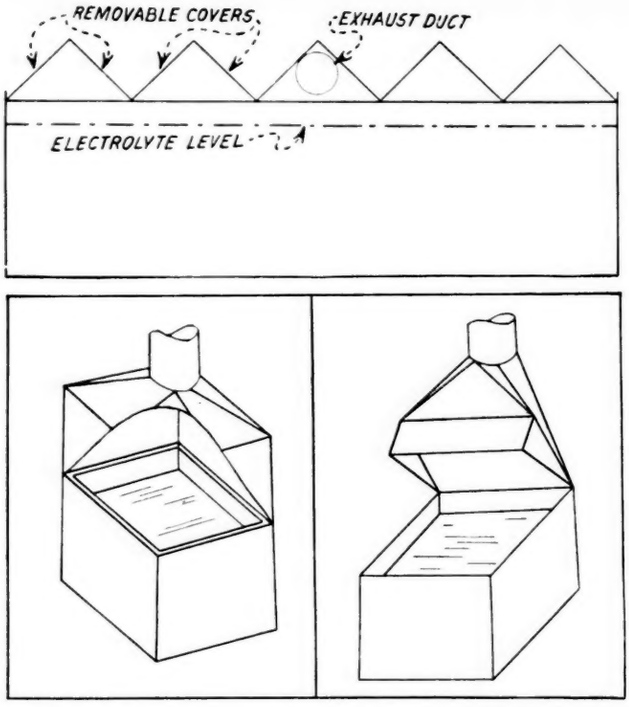


Fig. 63 (Top) Suggested cover design and exhaust for electro-plating tank. Fig. 65 (Lower Left) Two-sided exhaust for hot water tank. Fig. 66 (Lower Right) Angular hood for hot water tank.

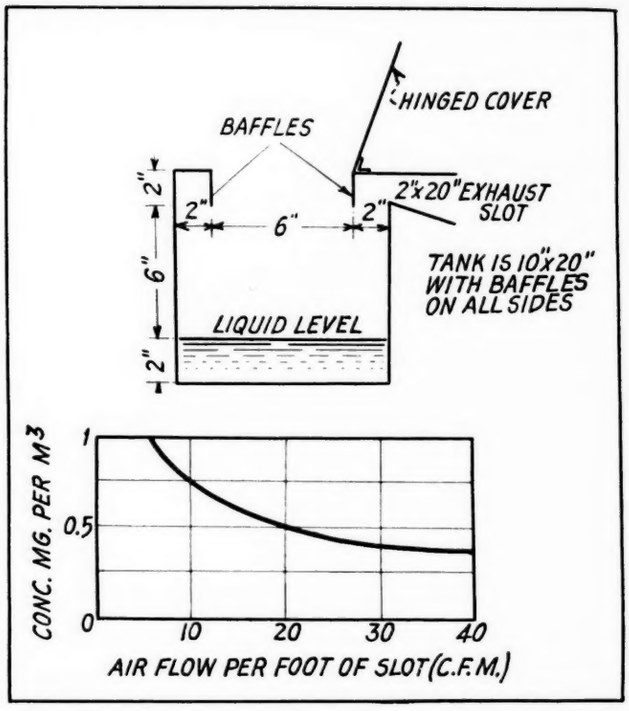


Fig. 64 Wire impregnating tank and relation between air flow and concentration under operating conditions.

The exhaust slot is located in the rear section and runs the length of the tank. Widths of ½ to 1 inch are deemed sufficient. The tank proper is covered as indicated. Inlets are provided to maintain a directional flow to the exhaust slot. Air flows of approximately 100 cubic feet per square foot of evaporative area effectively remove the vapor present. Slot areas should be such that the air velocities do not exceed 300 feet per minute.

When condenser coils are absent, the slots should extend around the periphery of the tank. The degreaser fluid should never come closer than 10 inches to the slots and the tank should always be covered. Loss of degreaser fluid may be eliminated by a separate condenser located in the duct system.

Electroplating. Overhead exhausts are of infrequent use in electroplating establishments. The general velocity characteristics of such hoods were discussed in Part 1, and it is readily seen that air volume requirements must be quite high to obtain effective removal of mists and vapors. Electroplating tanks are generally exhausted by lateral openings or slots, as shown in Fig. 62, or are totally enclosed with removable covers and exhausted by a connection placed as shown in Fig. 63. In the last-mentioned type, the vapors and mists are removed by an inward leakage of air. Large automatically-operated tanks are generally enclosed, although local exhaust through slots is used at all openings.

Aside from chromic acid, most electrolytes do not present serious exhaust problems. However, the use of high current densities in electroplating processes in recent years has caused electrolytes to heat considerably and create quantities of mist. Certain noxious gases are also formed in some processes, and must be removed. The control of mist which depends largely upon current density is perhaps the most important problem requiring control. Chromic acid mist is the most important of these gases. In order to reduce chromic acid mists to safe limits by lateral exhausts, the air volumes should be about:

$$Q = 100\ L \times W \quad (28)$$

for a slot on only one side of a tank, and

$$Q = 50 \times L \times W \quad (29)$$

if on the two long sides.[20] The terms of the equations are as follows:

Q = air volume in cubic feet per minute,
L = length of tank in feet,
W = width of tank in feet.

For hoods of the type shown in Fig. 63, air volumes should be approximately 50 cfm per square foot of tank area. While in most instances leakage alone is capable of providing this air flow, special slots should be cut in certain covers to make sure the air supply is adequate.

Others have examined the nature of the airflow across tanks due to a single slot under suction.[21] Using an experimental tank with 2 inches slot width located 8 inches above a liquid surface, the following relations were found to hold:

For slot without flange

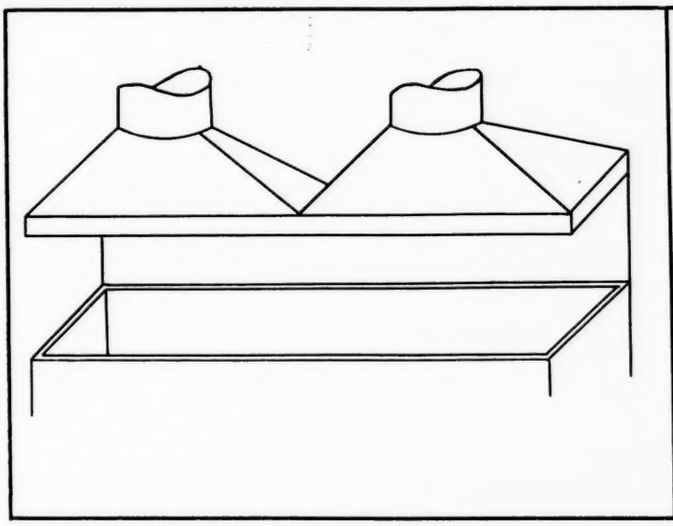
$$Q = 2.3\ W^{1.15}\ L^{0.85}\ V \quad (30)$$

and for a slot with flange

$$Q = 1.9\ W^{1.3}\ L^{0.7}\ V \quad (31)$$

[20] E. C. Riley and F. H. Goldman, 1937. Control of Chromic Acid Mists from Plating Tanks. Public Health Reports 52:172-174.

[21] Leslie Silverman, 1941, Fundamental factors in the design of lateral exhaust hoods for industrial tanks. Journal of Industrial Hygiene & Toxicology, 23:187-195.



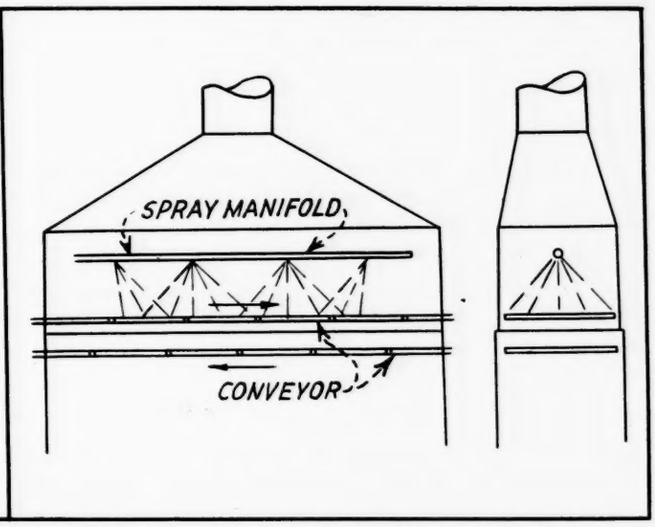


Fig. 67 (Left) Double section hood for cyanide tank. Fig. 68 (Right) Enclosure for automatic washing device.

where Q = volume of airflow in cfm,
W = width of tank in feet,
L = length of tank in feet,
V = velocity at opposite edge of tank in feet per minute.

Assuming that a linear velocity of 50 feet per minute is required at the opposite edge (which is not unreasonable), we see that the first of these equations yields results almost identical with Equation 28. Silverman also found that a slot width of 2 inches was preferable to smaller slots in the case of slots without flanges, but that this was not so important for flanged slots. As to depth of liquid it was found that for a fixed air volume, velocities at the opposite edge were somewhat improved.

One other item of some importance must be mentioned. Care should be taken to provide a uniform flow of air throughout the whole length of slot. There is always a tendency for more air to move through sections of the slot closest to the fan, even though the manifold behind the slot is properly proportioned. Whenever a large manifold must be used, as is often the case with long tanks, suitable vanes should be inserted in the manifolds to provide a uniform flow of air along the slot. Experience shows that without such vanes the ventilation across the tank surface cannot be made uniform.

Wire impregnating. Tanks used for impregnating insulated wire or cable employ lateral exhaust ventilation. Hinged covers are also used, which are kept closed except when adjustments are made. Fig. 64 illustrates a design found effective for the control of certain impregnating compounds.[22] The tank consists of a hinged cover and a single slot two inches in width. For the control of chlorinated naphthalenes in narrow impregnating tanks (10 in. wide), the air requirements should be approximately 20 cubic feet per foot of slot when the tank is open. Baffle arrangements similar to those shown in Fig. 66 considerably reduce the air volumes required. It is preferable to have such baffles hinged in order to facilitate cleaning the tanks.

The liquid should be kept at least 6 inches below the level of the exhaust slots.

The air volume requirements for tanks wider than 10 inches should be increased. Care should be taken to keep air flow below 50 cu ft per foot of slot (open tank), since particles may be picked up and thrown into the room air by an overbaffling action.

Hot water and dye tanks. Figs. 65 and 66 suggest two types of hoods to be used for hot water and dye tanks in the felt hat industry. The hoods for these tanks must be so located that the operations of the worker receive a minimum interference. As in all steam removal problems, these hoods should provide air flows of 150 cfm per square foot of opening. The hood shown in Fig. 66 should project over at least one-third of the area of the tank in order to be effective. Note that contour distributions for this condition are similar to those in Fig. 26.

Cyaniding. A suggested design for cyaniding small parts is given in Fig. 67. An air flow of 300 cfm per square foot of opening is generally used. The hoods serve a twofold purpose: They remove vapors generated during the cyaniding process, as well as the gases developed in heating the cyanide containers. The hoods used must be constructed of heavy metal.

The two-section hood shown in Fig. 67 adds flexibility. It allows a saving of air in event all cyanide containers are not in use. Due to the heat generated, however, it is probable that upward surge of air is accentuated, with the result that more air is drawn from the vertical portions than would be calculated from Equation 20.

Automatic washing machines. The schematic drawing shown in Fig. 68 illustrates a type of automatic washing device frequently used. It consists of a hood with vertical enclosures except at the two ends. The material to be cleaned passes through the tank by means of the conveyor. Steam and water mist are effectively removed by providing air

[22] C. P. Yaglou, F. W. Sands, and Philip Drinker, 1938. Ventilation of wire impregnating tanks using chlorinated hydrocarbons, Journal of Industrial Hygiene & Toxicology, 20:401-418.

Figs. 69 and 70. Canopy hood for small (left) and large (right) electric furnaces.

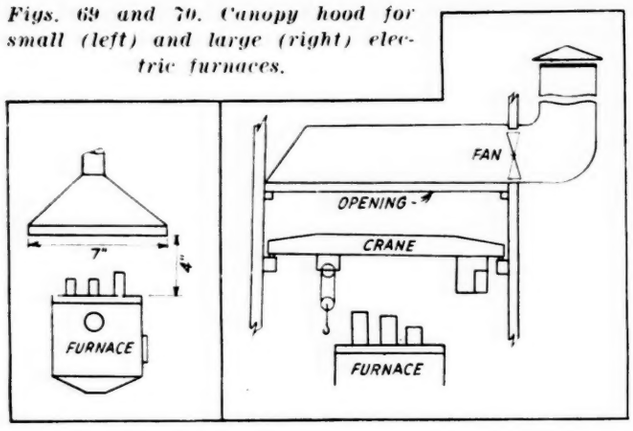
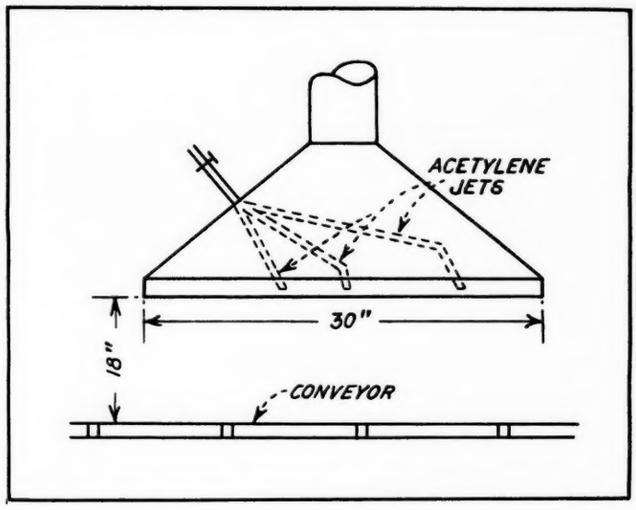


Fig. 71 (Right) Hood for permanent mold preparation.



flows equivalent to 100 cubic feet per square foot of opening at each of the open ends.

Canopy-type Hoods for Smoke, Fumes, and Gases

Hoods for Electric Furnaces. These hoods remove smoke and fumes generated by the hot arc of the furnace. They rise rapidly and the hood acts to trap them. Fig. 69 illustrates the relative position and dimensions of a hood located above a five-ton steel furnace. It extends laterally a short distance beyond the projected limits of the furnace. The hood shown is square. Air volume requirements range from 120 to 200 cfm per square foot of opening. Higher velocities are required when the distance between the hood and furnace is increased.

Larger steel furnaces are best exhausted near the building roof by means of propeller-type fans. Hoods for such furnaces may follow the general pattern shown in Fig. 70. The hoods must be located above the crane level. The fan size should be calculated on a basis of 200 cfm per square foot of opening area. Larger air volumes tend to increase the air changes to prohibitive amounts when the primary function of those hoods is to eliminate the smoke nuisance.

Exhaust for permanent mold preparation. In many foundries the use of permanent molds, especially for small parts, requires methods for their preparation prior to pouring. This preparation consists of applying a thin layer of carbon by means of acetylene flames over the surface contacted by the molten metal. The operation may be done automatically under a hood arrangement similar to that suggested in Fig. 71. The design given in the figure consists of a 30-inch square hood in which several jets are placed. As the permanent molds move along the conveyor, the flames apply a layer of carbon over the surfaces projected immediately below. Not more than 75 cubic feet per minute per square foot of opening is required for operations of this type.

Hoods for tinning and soldering. Tinning and soldering operations, especially of radio and small electrical parts, involve some exposure to lead and flux fumes. Several hood forms are possible for covering solder pots, but such hoods should also function in removing fumes during the manipulation of parts. Fig. 72 shows a practical design which is widely used. The stove hood encloses the heated soldering iron and also provides an opening to remove some of the fumes and smoke created. The grille-top bench with hopper also serves to remove fumes and fine particles which fall during the soldering process. If surfaces are filed, the fines are easily collected. Both the stove hood and grille top bench are exhausted at a rate of 75 cubic feet per square foot of opening. Pipe sizes should be such as to provide a velocity of approximately 2500 fpm.

A floor grid is provided to improve housekeeping and avoid the dispersion of solder fines formed during filing.

(Next month's installment will cover booth-like structures for control of fumes).

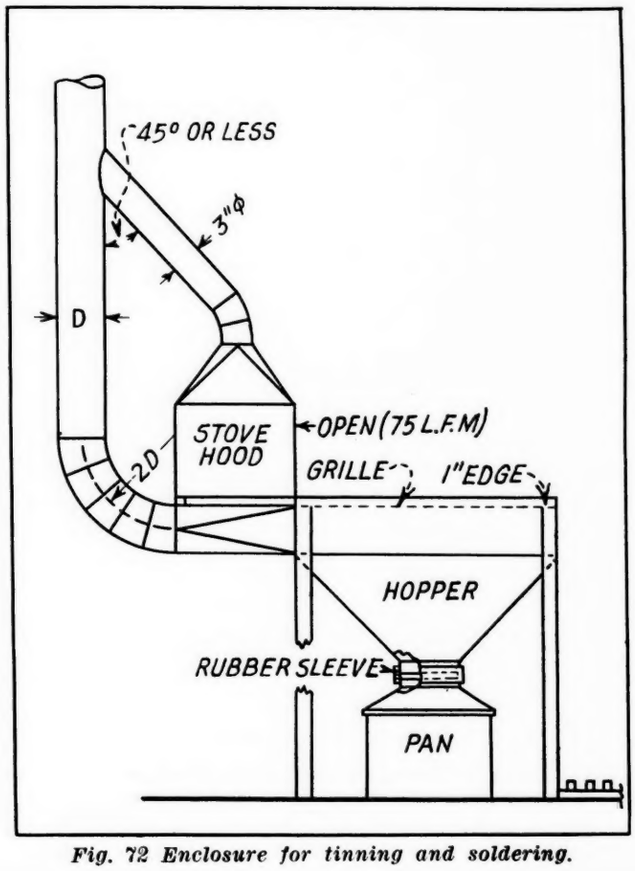


Fig. 72 Enclosure for tinning and soldering.

WASHINGTON NEWS

Summarized by Loring F. Overman.

Oil Conversion Program Abandoned; Heating Controls Released by WPB; A. C. Repairs Facilitated by P-126.

Highlight of September activities in Washington, as they affect the heating, ventilating and air conditioning industries, was the suspension of the Petroleum Administration's program for the conversion of industrial and commercial oil-burning equipment to the use of coal. Efforts to effect conversion of domestic heating systems were discontinued some months ago.

Disconcerting is the reason given for the suspension of the program—"uncertainties in the coal situation, including the shortage of delivery equipment and manpower for retail coal delivery."

"No one should construe this suspension of the industrial and commercial conversion program as meaning we are 'over the hump' as far as oil supplies are concerned," said Petroleum Administrator Harold L. Ickes. "War developments might make it necessary at some future time to resume the program, especially in view of the fact that we are still faced with an over-all shortage of oil in the United States."

Suspension of conversion activity does not apply to conversions now in process, the PAW announcement emphasized, inasmuch as the supply program for the coming winter has been based on the assumption that oil requirements will be reduced by the amount now used in these facilities.

Reviewing the conversion campaign to date, Deputy Administrator Ralph K. Davies pointed out that industrial conversions to date have resulted in savings equivalent to 176,500 barrels of fuel oil per day.

Oil Stocks Below 1942

Although East Coast stocks of principal petroleum products available for civilian consumption have continued their weekly upward trend, total inventories are considerably below those for the same period of 1942. Quoting from the American Petroleum Institute's weekly index, PAW Administrator Ickes reported on September 18 that civilian stocks had risen to 42.5% of normal, compared with 41.9% during the previous week. For the same period of 1942 the index stood at 59.8% of normal.

"Although the new index figure shows a fractional improvement," commented Mr. Ickes, "we still have a lot of work to do before we get into even as good a position as we were last year. A hopeful aspect of this week's developments is that our inventories of heating oil again moved upward, as they have every week since August 14. They are not yet to a point where we can relax our efforts to build up stocks. Knowing the very heavy military demand that lies ahead, we must do everything possible to build civilian supplies to a point where there is an adequate cushion against emergencies."

OTD Curbs Nationwide

While the Office of Defense Transportation delivery restrictions to be extended to the entire country on October 11 will not limit deliveries of fuel, their extension emphasizes Washington's growing concern over decreasing overall stocks of petroleum. In effect in 12 Eastern states since May, the ODT restrictions limit the number of weekly wholesale and retail deliveries of all commodities. Ice, fuel and milk are given a blanket exemption.

Back of the decision to make the delivery restrictions nationwide in effect is the following picture of the gasoline situation.

Gasoline Situation (Barrels per day)	
Pre-Pearl Harbor Production (Largely for civilian use)	3,500,000
Present production	4,000,000
Military requirements, excluding aviation	1,000,000
Military aviation requirements	1,000,000
Balance for civilian use	2,000,000
Estimated shortage, civilian	1,500,000

Conservation Program Launched

Over the signatures of Donald M. Nelson, chairman, War Production Board; Harold L. Ickes, Solid Fuels Administrator for War and Petroleum Administrator, and Joseph B. Eastman, Director, Office of Defense Transportation, a nation-wide conservation program seeking the cooperation of national trade associations and trade journals was launched in Washington September 15.

"This program," explains the jointly signed letter of announcement, "calls for voluntary actions by the public and by industry to make important savings in the domestic and commercial use of such critical resources as manpower, materials, equipment and fuels through conservation of coal, petroleum products, electricity, gas, water, communications and transportation.

"Although savings in a single household, commercial establishment or industrial plant may seem insignificant, the possible aggregate savings are tremendous. It is estimated, for example, that a 10% reduction in domestic and commercial use of coal for *heating* would save over 20,000,000 tons annually; a 10% reduction in domestic and commercial use of electricity would save over 4,000,000 tons of coal and more than 75,000,000 light bulbs; a 10% reduction in the use of manufactured gas would save over 1,500,000 barrels of fuel oil. In addition, vast quantities of other critical materials, manpower and transportation would be released."

Uncle Sam on Heat Saving

In the conservation campaign, which will be given national publicity through the extensive public relations facilities of the three sponsoring agencies, the federal government again carries the ball for the heating and ventilating industries, by lending official sponsorship to many of the principles these industries have fostered for many years. As an example, the following campaign material from conservation campaign material:

"TO SAVE FUELS (gas, oil, coal):

1. Heat-seal the Home
   - (a) Insulate walls and ceilings
   - (b) Install weather stripping
   - (c) Install storm doors and windows
   - (d) Calk cracks to prevent heat leaks
2. Keep Furnace in efficient condition.
   - (a) Gas and Oil
     1. Clean the flue passages
     2. Make a complete combustion check-up
     3. See that the draft regulator is properly adjusted
     4. Seal all air leaks
   - (b) Coal
     1. Clean the chimney, flue passages, fire pot and interior parts

2. Repair air leaks in the smokepipe, furnace doors and other parts with insulating cement
3. Make sure thermostat and stoker, if you have them, are properly adjusted.

3. Cut heat load.
   (a) Avoid overheating or the heating of unnecessary spaces such as unused rooms, basements, bedrooms, etc.
   (b) Pull shades to bottom of window and draw draperies at night.
   (c) Remove any barriers that block heat from spreading evenly into rooms, such as furniture in front of radiators, screens and decorative covers around radiators, etc.
   (d) Shut off heat whenever weather permits at night, on Sundays, holidays, etc.
   (e) Eliminate unnecessary ventilation. Don't throw windows open to cool off rooms. Keep windows closed. Normally, plenty of "fresh air" enters the room through openings around the window frame. The windows need never be open more than a "crack" even at night.
   (f) Keep night temperature down to 65 F during day and 60 F at night.
4. Use as little hot water as possible and turn off water heaters prior to departure for any great length of time. Don't use running water to wash or shave. Use less water for bathing — where possible take a quick shower."

Heating Controls Released

As a further contribution to the fuel conservation drive, the WPB Plumbing and Heating Division, by amendment of Limitation Order L-79, has released from previous priority rating requirements 23 types of heat-control instruments. Despite the fact that some manufacturers have sizeable inventories of these instruments which they have been holding awaiting rated orders, the release provision of L-79 has put few controls on the shelves of jobbers and dealers anxious to make deliveries to civilian consumers.

Holding up deliveries by manufacturers is the fact that the WPB Requirements Committee has not yet allocated materials for manufacture of controls to replace those now in stock and those estimated as needed for the expanded program. Initial requests filed by the Plumbing and Heating Division for blanket allocations covering the entire list of controls were turned down by the Requirements Committee, which countered with a request that the division present a revised list of controls requiring a minimum of scarce materials but assuring a maximum of fuel saving. The division was also asked to report which manufacturers were in a position to manufacture controls and to estimate how long it would take to get the program into operation.

This information has been provided by the Plumbing and Heating Division and it was expected that by October 2 the WPB requirements committee would have made allocations for the fourth quarter of 1943. Executives of the division emphasize that release of controls for 1943 use will not have to await actual manufacture, since manufacturers will release present inventories as soon as materials for replacement are in sight.

Manufacturers having capacity to produce controls are to be asked to file supplemental CMP 4-B applications covering requirements. To speed processing, such applications are to be marked with a special designation, "Fuel Conservation Drive."

Jobbers seeking to replenish stocks of controls will file WPB Form 547, filled out to anticipate building up a 60-day inventory.

A detail yet to be worked out in connection with the release of inventoried stocks of controls is the desire of the military forces to earmark certain quantities that might otherwise be released to civilians. The Plumbing and Heating Division has suggested that military forces file with the Requirements Committee a supplementary request for materials allocations to cover manufacture of controls for military purposes.

FUEL CONSERVATION

The United States Government is sponsoring a broad program to save fuels. This program, which started in mid-September, calls for voluntary action by the public and by industry to make important savings in the domestic and commercial use of these critical resources. It has the support of the War Production Board, Solid Fuels Administration, the Office of Defense Transportation, Petroleum Administration for War, and the Office of War Information, and is being carried forward by all the industries concerned.

Although the savings in an establishment or industrial plant may seem insignificant, the possible aggregate savings are tremendous. It is estimated, for example, that a 10% reduction in domestic and commercial use of coal for heating would save over 20,000,000 tons annually; a 10% reduction in domestic and commercial use of electricity would save over 4,000,000 tons of coal and more than 75,000,000 lamp bulbs; a 10% reduction in the use of manufactured gas would save over 1,500,000 barrels of fuel oil. In addition, vast quantities of other critical materials and manpower would be released.

With the war approaching a decisive stage, the need for conservation has become more urgent than ever before. A comprehensive program of information linking all phases together will be carried on by the government, and the industries themselves will conduct national and local campaigns explaining in detail exactly what each individual can do to conserve critical resources.

P&H Division Changes

Lawton Ganey, in charge of the controls program, has been named acting chief of the heating branch of the Plumbing and Heating Division of WPB, succeeding William F. Bilyeu, who died September 23, following a brief illness. Mr. Bilyeu joined the Plumbing and Heating Division in November, 1941, prior to which time he had acted as eastern division manager for the Modine Manufacturing Co., Racine, Wis. Aged 60 years, Mr. Bilyeu had been associated with the industry for 25 years, and had been with the Trane Co., Warren Webster and Co. and John J. Nesbitt, Inc.

Vincent Mannis, chief of the plumbing division, has returned to National Housing Administration and Dennis Ganey, Chicago Faucet Co., has been appointed to succeed him. Mr. Ganey is a dollar-a-year man.

Lewis Brewer, administrative assistant, has transferred to a similar position with the Office of Civilian Requirements.

Civilian Output Safeguarded

To prevent the limited supplies of manufactured goods earmarked for civilians from uncontrolled diversion to the armed forces, WPB will issue directives to individual manufacturers specifying the percentage of their production that is to be distributed to civilians through the customary trade channels during the fourth quarter of 1943.

Each directive will state that it does not authorize the manufacturer to disregard preference ratings or WPB orders or regulations, but if they would prevent him from shipping to civilians the stipulated percentage then the manufacturer must notify the WPB, which may then issue pertinent instructions.

Action that would protect civilian goods from military requisition has

been under discussion for some time and the directive finally decided upon is not as strong as the policy previously considered. Included among products to be affected by the directives are cast iron boilers, cast iron radiators, warm air distribution equipment, registers, stoves, smoke pipe, warm air furnaces, hot water equipment, heaters, and domestic tanks.

A-C Repairs Facilitated

Preference Rating Order P-126, as amended September 16, simplifies procedure for obtaining repair parts and materials for maintenance and repair service for essential industrial and commercial refrigerating and air conditioning systems. The amendment also removes provisions limiting the use of preferent ratings to service agencies holding certificates of authority and serial numbers issued by WPB.

The amended order defines a service agency as any individual or firm which engages in repairing systems belonging to others. It assigns preference ratings and CMP allotment symbol MRO to purchase orders for maintenance and repair parts and materials placed by any service agency, according to uses of the systems for which they are needed.

Systems and applicable preference ratings follow:

Class I: AA-1-MRO, for systems used in industrial food manufacturing, processing, packaging, preservation, storage or transportation, or for purposes listed in Schedule I of CMP Regulations 5 and 5A.

Class II: AA-2-MRO, for systems used in restaurants, hotels or retail stores, exclusive of air conditioning systems; in milk cooling on farms; or purposes listed in Schedule II of CMP Regulation 5 and 5A. Also in Class II are parts and materials needed to build up the service agency's inventory to the largest permitted amount.

Class III: AA-5-MRO, for systems (except air conditioning) used for purposes not listed in Schedules I and II of CMP Regulations 5 and 5A or in Class II.

Controlled materials for Class III uses may be bought only with special WPB permission; application is made at local WPB offices on Form WPB-541 (formerly PD-1A). Controlled materials for repair and maintenance of Class I and II systems may be bought with the preference ratings designated, with the exception of aluminum. This must be obtained in accordance with the provisions of CMP Regulations 5 and 5A.

To permit newly established service agencies to maintain sufficient inventories, former inventory limits based on 1941 inventories have been changed. A service agency may build up an inventory, estimated in dollar value, needed to continue emergency repair service for a 60-day period according to its current method and rate of operation.

Cooperating Committee Formed

The appointment of a six-man committee of representatives of fuel oil distributors to assist the Fuel Rationing Division was announced today by the Office of Price Administration. The appointments will make possible increased cooperation between industry and the OPA.

The six members of the panel are official representatives of their associations and have been named upon the recommendations of the Oil-Heat Institute of America and the Atlantic Coast Oil Association Conference.

It is expected that the group will operate similarly to the dealer committees which have worked out so effectively in assisting OPA regional and district offices, OPA said. The committee's advice will be sought regarding the operational problems which arise in administering the fuel oil rationing program.

The appointments are as follows, with the recommending group in parenthesis:

Harry Evans (Atlantic Coast Conference), chairman, New York Harbor Committee, and affiliated with Kleen Heat Sales Corporation, Brooklyn, N. Y.; Elwin E. Hadlick (Oil-Heat Institute), president, Northwest Petroleum Association, Minneapolis, Minn.; Lionel Jacobs (Atlantic Coast Conference), chairman, Atlantic Coast Oil Associations Conference, Automatic Heat Incorporated, Philadelphia, Pa.; W. F. Scheierholz (Oil-Heat Institute), president, Fuel Oil Association of Saint Louis, president, Fuel Oil Company of Saint Louis, Mo.; Lester Scott (Oil-Heat Institute), director, Oil Heating Division, Merchants and Manufacturers Association, Washington, D. C.; Frank E. Spencer (Oil Heat Institute), chairman, Distribution Division, Oil-Heat Institute of America, Socony-Vacuum Oil Company, Chicago, Ill.

Burner Service Price Set

Uniform maximum prices for repair and maintenance services on oil burners were established September 24 by the Office of Price Administration through issuance of Supplementary Service Regulation No. 19 to Maximum Price Regulation 165. The new ceilings vary according to the size of the city in which the service is performed. The maximum for cities of 500,000 population or over is $2.50 for the first hour and $1.75 for each succeeding hour. For cities of 100,000 to 500,000 the ceiling is $2.00 for the first hour and $1.50 for succeeding hours, and for cities less than 100,000 the top price is $1.50 for the first hour; $1.25 for succeeding hours.

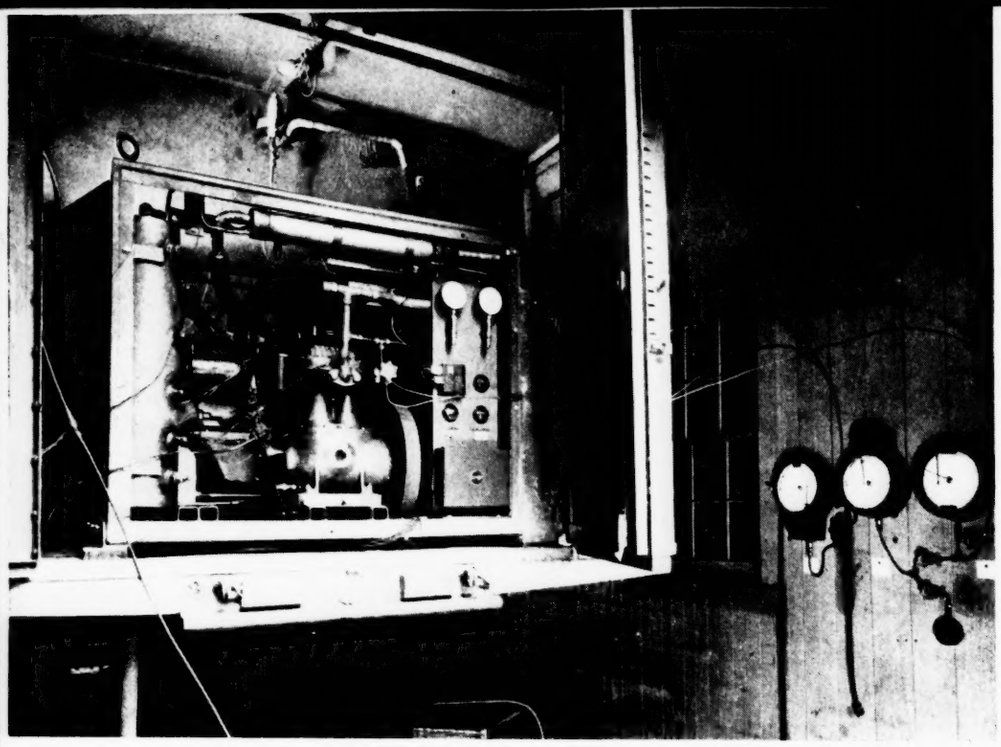
Essentiality of Air Conditioning

The essentiality of air-conditioning to certain scientific and manufacturing processes was recognized by WPB in a recent amendment to Conservation Order M-28, which controls supplies of Freon. Although tightening control of the refrigerant for some uses, the amendment lists 27 specified uses classified as so important that purchases of Freon may be made by users without WPB authorization. Among the 27 are air conditioning to maintain prescribed conditions in laboratories conducting tests on parts or instruments for aircraft, combat tanks, ships, radio equipment; air conditioning for temperature and humidity control in the production of gyroscopic instruments and compasses; air conditioning in the production and storage of penicillin and blood serum; refrigeration for cooling X-ray apparatus used in analyzing castings in aircraft and other combat vehicles; and refrigeration for low temperature chambers designed to duplicate substratospheric conditions for testing instruments, flying clothes, personnel and equipment.

The tightened control under the amended order is effected by requiring certification of purchase orders by Freon users to the effect that the refrigerant is needed for immediate use. Certification formerly stated that the refrigerant would be needed within the next 30 days. The change, in effect, means that Freon may be purchased only in case of actual breakdown, and not for standby charges, except as specifically designated by WPB.

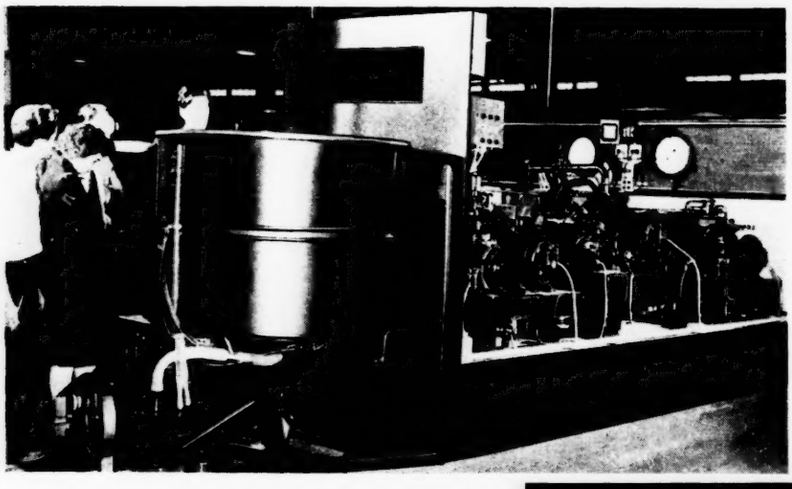
Boiler Price Committee Named

The following have been appointed by the Office of Price Administration to serve on an OPA Cast Iron Boiler and Radiator Industry Advisory Committee: Virgel A. Good, sales manager, Burnham Boiler Corporation, Irvington, N. Y.; Ralph P. Henderson, vice-president in charge of sales, United States Radiator Corp., Detroit, Mich.; L. N. Hunter, vice-president, National Radiator Co., Johnstown, Pa.; Irving L. Jones, president, International Heater Co., Utica, N. Y.; Max D. Rose, assistant general sales manager, American Radiator and Standard Sanitary Corp., Pittsburgh, Pa.; Carl Sawade, manager, Utica Radiator Co., Utica, N. Y.; Stanley K. Smith, vice-president, The H. B. Smith Co., Westfield, Mass.; William R. Stockwell, manager, manufacturing division, Weil-McLain Co., Michigan City, Ind.

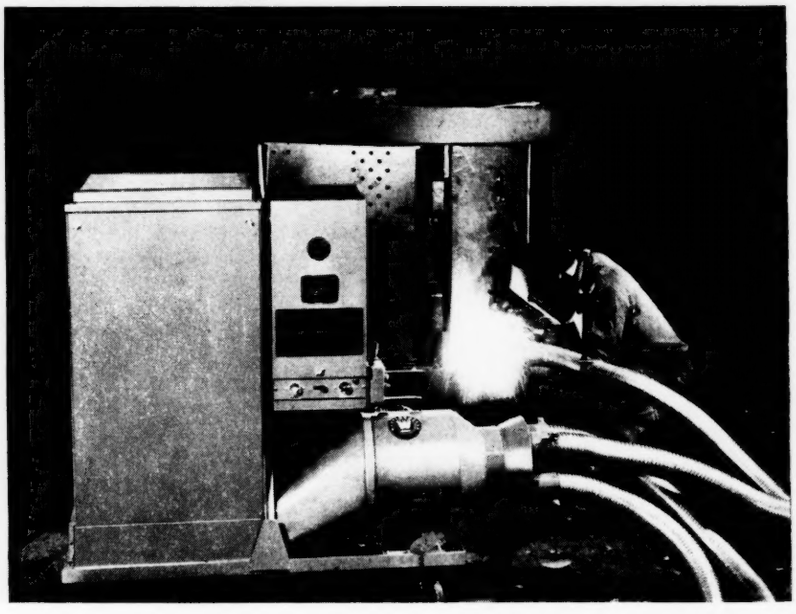


REFRIGERATED TRUCK TRAILER. Criss-crossed by a maze of thermo-couples this new type Army refrigerated truck trailer is being tested for its resistance to man-made heat wave created by engineers of the York Corporation. Mercury on the test soared to well over 120F although temperature inside could be maintained at 10F above. Independent of outside power, the truck trailer is equipped with a gasoline-driven refrigerating unit.

CYPRESS WATER TANK. Albert Kahn Associated Architects and Engineers, Inc., in cooperation with Chrysler Corporation, have produced a modernized design water tank for the Dodge-Chicago plant. Tank, one of two, is made of cypress. Each has a capacity of 100,000 gallons and is mounted 125 ft above grade on a cylindrical tower of reinforced concrete. Over 60 tons of steel were saved by using concrete and wood. Pump pit is inside the base. No frost casing was necessary because water pipes are entirely enclosed within the tower.

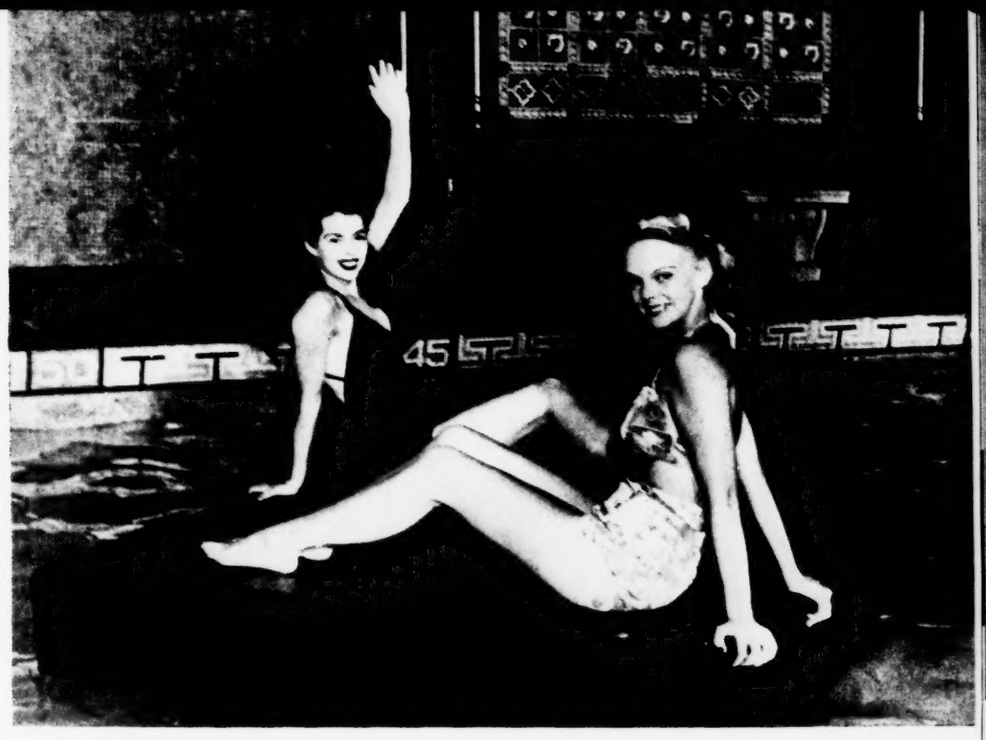


LOW TEMPERATURE BLOOD DESICCATING, developed by Deepfreeze Division, Motor Products Corporation, North Chicago, Ill., in operation by the Parke-Davis Company. Machine has inherent temperature control utilizing the expansion and contraction of the chilling chamber itself in connection with a Microswitch to secure infinitely variable temperature control.

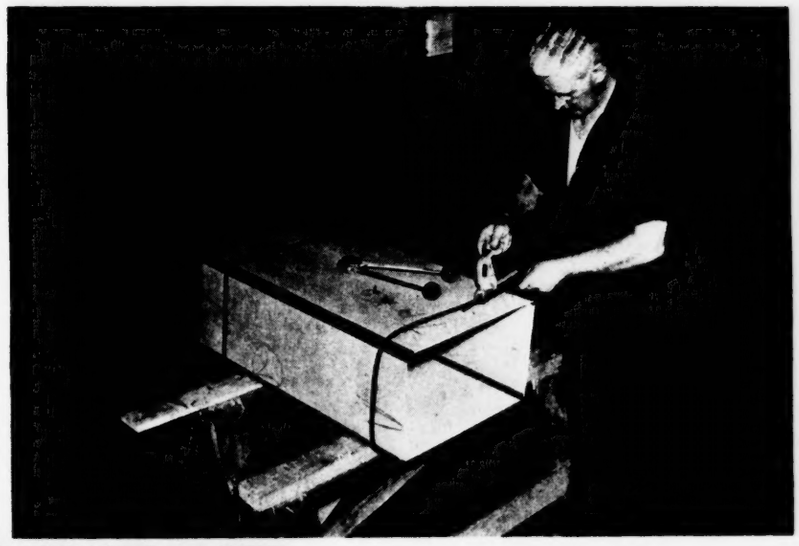


WELDING FUME REMOVER — One of the new uses of electronics in industrial functions is for removal of welding fumes directly from the scene of welding activity. A portable Westinghouse Precipitron electrostatic air cleaning unit with three flexible metal hoses can be moved to any plant welding location. Welding fumes drawn through the hoses pass through the air cleaner where 90% of the fumes and air borne particles are removed. The cleaned air is then returned to the room.

PICTURE PARAGRAPHS



GLASS THAT FLOATS! Gloria Gale (left) and Pat Ogden try out the first raft ever made of glass, in the swimming pool of the Park Central Hotel, New York. Foamglas, the glass that floats, was developed by the Pittsburgh Corning Corporation. It consists of tiny sealed air chambers. Comparable in weight to cork, Foamglas makes a mighty effective insulating material.



DUCT ASSEMBLY CUTS COSTS. Air duct of asbestos cement board set in Sheetlock prefabricated steel corners, with closure effected by Acme steel strapping which is tensioned and then sealed, with the result that a duct can be assembled in five minutes and at a saving of 40%. Duct sections can be joined together with three inch strips of asbestos material cemented over the joints.

NEVER BEFORE IN STEEL HISTORY has electrically cleaned air been passed through the turbo-blower that provides air for a blast furnace. The job is done at the Kaiser Co. steel mill near Fontana, Calif., by a bank of 120 Westinghouse Precipitron cells comprising the electric air cleaning device shown in the photo. The 90,000 cubic feet of air, sucked through huge Venturi tubes every minute, is freed of dirt particles down to 1/250,000 of an inch in size. The purpose of passing clean air into the blower is to keep sludge out of the blower case, increasing the operating efficiency of the unit and minimizing maintenance work that would be necessary if the turbine rotor had to be removed and cleaned periodically.

NEWS OF THE MONTH

Tasker Assumes Research Directorship

NEW YORK—Cyril Tasker entered upon his duties as Director of Research of the American Society of Heating and Ventilating Engineers here October 1. For the past 13 years Mr. Tasker has been a member of the staff of the Ontario Research Foundation and as senior research fellow has carried on many important investigations relating to fuels, and a variety of problems connected with heating and air conditioning.

Cyril Tasker

The selection of Mr. Tasker for the important assignment of carrying on the Society's research program was made by the committee on research and unanimously approved by the ASHVE Council.

Mr. Tasker was born in Manchester, England, and graduated from the University of Manchester in 1923 with the degree of M.Sc. (Tech.). Until 1930, when he came to Canada, he was on the staff of the British Fuel Research Board.

Industrial Hygiene Lectures

ANN ARBOR, MICH.—An inservice training course for plant safety personnel will be held at the School of Public Health, University of Michigan at Ann Arbor on October 19-21. Among the speakers and subjects are the following:

Environmental Aspects of Industrial Hygiene, R. R. Sayers, Senior Surgeon, U. S. Public Health Service; Control of Solvent Vapors and Acid Mists, W. G. Frederick, Chief Chemist, Bureau of Industrial Hygiene, Detroit Dept. of Health; Control of Smokes, Fumes and Gases, H. H. Schrenk, Chief Chemist, Health and Safety Division, U. S. Bureau of Mines; Evaluation and Control of Dusts, J. J. Bloomfield, Sanitary Engineer, Division of Industrial Hygiene, U. S. Public Health Service; Industrial Ventilation Practices, W. N. Witheridge, Director, Bureau of Industrial Hygiene, Detroit Dept. of Health.

The course is being given at the request of the Michigan Industrial Association which has found that the vastly increased tempo of industrial activity together with the limited supply of trained industrial hygienists available has made it necessary to depend more and more upon the cooperation of safety personnel in the excercise of controls intended to reduce or eliminate occupational illness. Therefore, this course is restricted to the environmental control phases and is designed specifically to aid safety engineers and other safety personnel in more effectively assuming and carrying out the responsibilities thus imposed upon them.

Further information is available from H. E. Miller, Resident Lecturer in Public Health Engineering, School of Public Health, University of Michigan.

Industrial Hygiene Meeting

PITTSBURGH—The eighth annual meeting of Industrial Hygiene Foundation will be held at Mellon Institute here November 10 and 11.

The Foundation's board of trustees, meeting in New York August 25, voted unanimously for the annual meeting as a help in maintaining healthful conditions in war plants, which in turn helps maintain manpower.

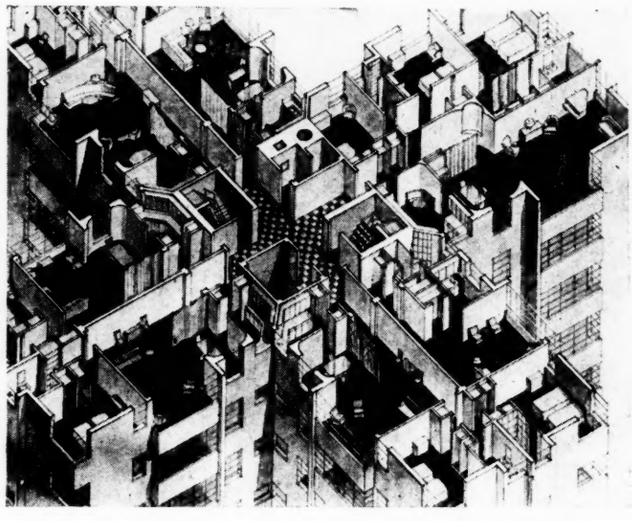
Minneapolis-Honeywell Sponsors Prize Contest

MINNEAPOLIS — Apartment design and construction, dormant since the start of the war, is the subject of a Minneapolis-Honeywell Regulator Company $10,000 competition for the best heating designs submitted by contestants.

Using a hypothetical six-story apartment building, prizes will be awarded for designs of a system of steam heating and its control, and a system of hot water heating and its control. Contestants will assume that the design of the apartment building has progressed architecturally to the point where it is now necessary to prepare its heating layout.

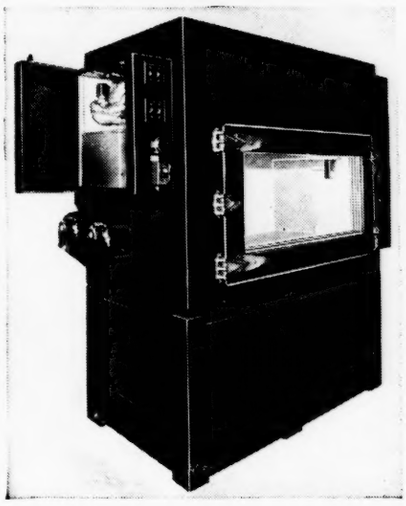
Detailed instructions with complete architectural layouts will be provided each contest entrant, together with an informative booklet describing personalized apartment heating. Any person, except company employees, may enter the contest simply by writing to the company. Separate prizes will be awarded for the best solution based upon a system of forced hot water heating and a system of steam heating. First prize in each group will be $2,000, second prize in each group will be $1,000 and third prize will be $500. In addition, there will be 20 honorable mention prizes of $150.

All entries will be judged anonymously by a jury consisting of a nationally recognized consulting engineer, a nationally recognized architect, and a representative of Minneapolis-Honeywell. The contest will close November 15, 1943.



Typical six-story apartment house of the future in which each tenant will be able to obtain and control the required temperature.

NEWS OF EQUIPMENT AND MATERIALS



Humidity Test Chamber

NAME—Amcoil humidity test chamber.

PURPOSE—For tests on delicate mechanisms and precision equipment.

FEATURES—Has a positive forced air circulation which can be varied in volume, thermostatic temperature control, a two-stage Freon condensing unit, and other standard refrigeration accessories; in addition, has a new attachment for automatic humidity control. The all-steel cabinet is equipped with a 51½ x 26½ in. access door fitted with a 46 x 21½ in. observation window having five thicknesses of sealed and dehydrated glass.

SIZES AND CAPACITIES—Standard range: ambient to 140F temperature, ambient to 90% relative humidity. Cabinet 95 in. x 91 in. x 42 in. overall, with 25.9 cu ft contents.

MADE BY—*American Coils Co.*, 25-27 *Lexington St., Newark, N. J.*

Field Draft Control

NAME—Type RA Field barometric draft control.

PURPOSE—Control is adjustable to provide correct balance of draft in either vertical or horizontal pipe installations.

FEATURES—Design principle compensates for the different way in which smoke flows in a vertical pipe as compared to a horizontal pipe. Device provides for equal accuracy in either position and at any setting. Follows the original Field design which includes, an off-center gate mounting for greater sensitivity, a deep collar which places the gate outside the flow of gases from the fire, rocking chair axis action which tends to neutralize force of friction, and factory-balanced gate. A non-adjustable unit of this design is also being introduced, which is set at the factory to maintain the draft desired by the manufacturers.

SIZES AND CAPACITIES—6 inch.

MADE BY—*The Field Control Division, H. D. Conkey & Co., Mendota, Ill.*

Tag Thermometer

NAME—Tag industrial thermometers.

FEATURES—Has plastic case front, yellow back, easy reading thermometer tubing and malleable iron back. By using a plastic case front, weight is reduced. Plastic case front is not affected by the temperatures to which the case is subjected under actual service conditions. Either the glass or the entire front can be replaced at nominal cost.

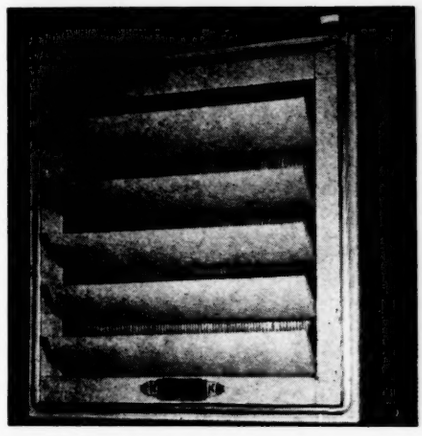
MADE BY—*C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.*

Unit Coolers

NAME—Victory Model Coolmaster.

PURPOSE—For space cooling and to comply with limitations on critical materials.

FEATURES—Has an all-steel hot galvanized coil without any welded or soldered return bends. Equipped with one-man suspension brackets for easy mounting. Heat interchanger accurately rated, based on standard tests. Unit can be used with Freon, methyl chloride, sulphur dioxide, ammonia or brine. Fan blade assembly carefully balanced and direct-connected to a totally-enclosed motor.



Unit finished in attractive chrome gray shade of crackle, baked on a bonderized base.

SIZES AND CAPACITIES—Seven sizes from 515 to 1990 cfm and 2900 to 23,000 btu.

MADE BY—*Kramer Trenton Co., Trenton, N. J.*

High Pressure Axial Flow Fan

NAME—586B Axial Flow Fan.

PURPOSE—A single, two-blade propeller fan for recirculation of cabin air through gasoline combustion heaters, for use on medium and heavy bombers and light, fast boats.

FEATURES—Inside diameter 6 in., weight 5.7 lb, powered with a 1/5 hp series-wound 24-28 volt motor, and delivers 320 cfm standard air at sea level against 2 in. water gauge pressure, or 450 cfm against 1½ in., at 20,000 feet altitude. Recently the power has been increased to ½ hp and a second propeller added on a double-extended shaft (Catalog 586-SCB) to handle 25% more volume at double the original pressure. Still another unit of 7 in. diameter is now in the final stages of development and will deliver approximately 600 cfm at 5 in. pressure.

MADE BY—*Dynamic Air Engineering, Inc., 843 San Julian Street, Los Angeles, 14, Calif.*

Regan Resistor

NAME — Regan radiant heater and resistor.

PURPOSE — For high temperature radiant heating installations such as annealing ovens and electric furnaces.

FEATURES—Will not deteriorate at temperatures up to 1700F. The element consists of a helical coil of nickel chromium wire wound spirally around the refractory core. The binding posts and straps are of monel metal or nickel chrome, depending upon the user's specifications.

SIZES AND CAPACITIES — 32 to 220 volts.

MADE BY — *Techtmann Industries, Inc., 828 North Broadway, Milwaukee, Wis.*

Wat-R-Miser Evaporative Condenser

NAME — Wat-R-Miser evaporative condensers with built-in air filter.

PURPOSE—Wide variety of air conditioning and industrial applications such as cooling batch quenching fluids, cooling oil for large Diesels, and cooling jacket water, where built-in air filters protect against impurities in the cooling system.

FEATURES — Manufacturer points out that proper filtering of the air eliminates or greatly reduces four important up-keep problems: clogging of lines due to impurities in the system, plugged spray nozzles, excessive head pressures, and pump maintenance. Air filter feature is standard equipment on all models, from capacities of 5 to 100 tons. Filter is all metal, yet rust proof. Construction is such that it may be removed easily and washed or cleaned when necessary.

LITERATURE AVAILABLE — 16-page illustrated catalog.

MADE BY—*Drayer & Hanson, Inc., 738 East Pico Street, Los Angeles, 21, Calif.*

Plast-Anneal for Ventilators

NAME—"Plast-Anneal."

PURPOSE—A plastic protective coating now being applied after fabrication, to cover and protect surfaces and interstices of the various ventilating units built by the company.

FEATURES—According to B. K. Paget, Allen general sales manager, coating said to have a minimum salt spray resistance five times greater than galvanizing; other advantages claimed include a true colloidal suspension of color pigment, action as a rust inhibitor, and uniform distribution of covering and thickness of durable surfaces. A further advantage is that basic formula can be altered to produce protection for almost any requirement where atmospheric conditions present known concentrations of acid or alkaline solutions.

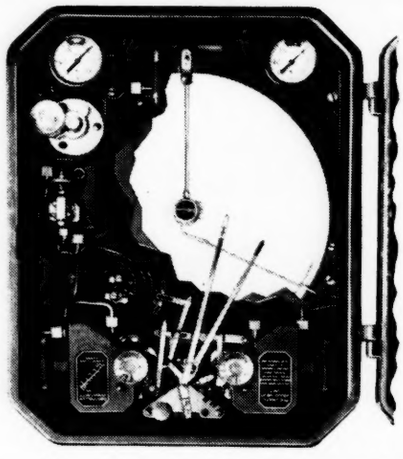
MADE BY—*The Allen Corp., Detroit, Mich.*

Taylor Pneumatic Set Controller

NAME — Taylor pneumatic set controller.

PURPOSE—A large variety of controlling applications where the set pointer of the controlling mechanism must be automatically and continuously adjusted in relation to variations in some other controlled or uncontrolled variable.

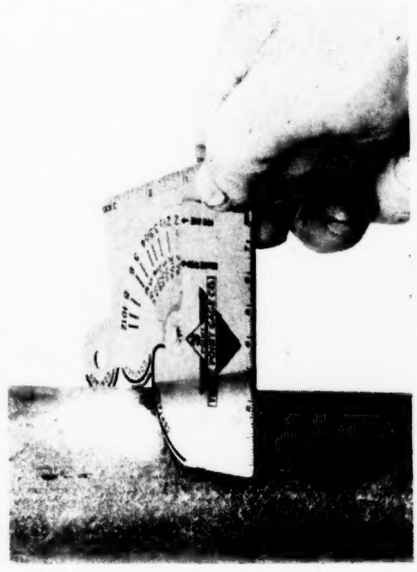
FEATURES — Developed to meet a demand for a dependable controller whose control point, as indicated by a set pointer, would be automatically adjusted by variations in output air pressure from another remotely located instrument, which may be an indicator, recorder, or controller. Device is in either the indicating or recording forms. This controller is fundamentally a Fulscope controller with an additional unit to convert changes in input air pressure into linear movements of the set pointer. The magnitude of the linear set pointer movement per pound change in input air pressure is governed by the setting of the adjustment dial provided in this unit. The unit also provides for set pointer adjustments



in either direction for an increase in input air pressure, and for limiting the travel of the set pointer within given limits. The instrument is also equipped with a manual set pointer adjustment feature. In air conditioning work Pneumatic Set makes it possible to keep a fixed temperature ratio between outdoors and indoors, thus eliminating the shock which is experienced when there is too great a variation between the two.

LITERATURE AVAILABLE — Bulletin No. 95158.

MADE BY—*Taylor Instrument Companies, P. O. Box 110, Rochester 1, N. Y.*



3-Point Pipe Gage

NAME—Three-Point gage.

PURPOSE — To give an accurate measurement of the size of pipes from ⅛ to 12 in.

FEATURES — Gage consists of two pivoted steel plates with edges curved at three points for contact with the pipe to be measured, together with scale which automatically registers pipe size in terms of inside diameter and drill size for tapping. Additional advantage is that only a small section of pipe is necessary for measurement and that gage can be used in dark places and taken into the light for reading. Constructed of steel with deep etched numerals. Size when closed is 2½ x 4¼ in.

MADE BY — *Three-Point Gage Company, 3821 Broadway, Chicago, Ill.*

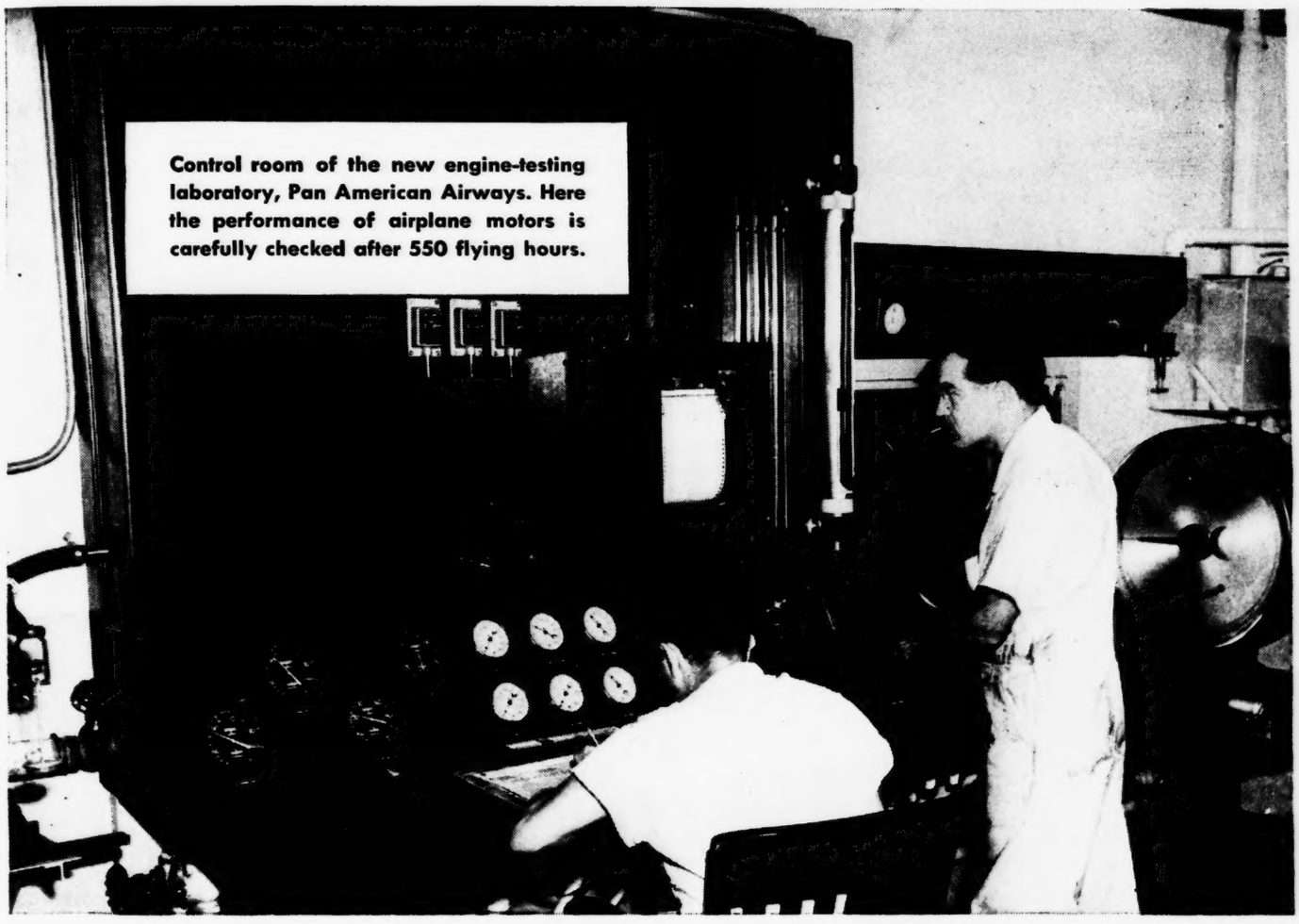
Protective Coating

NAME — Vescote ceramic protective coating.

PURPOSE—A protective coating for use where exceptional resistance to corrosive conditions and high heat are required, such as ducts, fans, blowers, exhaust, and air conditioning system.

FEATURES—Vescote is an inorganic finish applied by dip, spray or brush, and baked at 350 F for thirty minutes, either by convection type oven or infra-red lamps. It is non-inflammable, withstands heat over 1000 F, and is unaffected by standard 200 hour salt spray tests; offers extreme resistance to abrasion, solvents, acids, alkalies and the corrosive action of chemical liquids and fumes. It adheres tenaciously to ferrous and non-ferrous metals.

MADE BY— *Vesco Corporation, Vescote Division, 1383 Sedgwick Avenue, New York, N. Y.*



Control room of the new engine-testing laboratory, Pan American Airways. Here the performance of airplane motors is carefully checked after 550 flying hours.

How can these men look 550 hours into the future?

THESE MEN are watching testing instruments which are recording the performance of a Pan American Clipper engine. It is now roaring wide open in a separate sound-proof room.

The testing instruments which these men are reading give an accurate account of the engine's condition. They record fuel consumption, temperature, pressure . . . and performance characteristics.

After eight hours' running, printed records indicate the future of each engine tested. They tell these men definitely whether or not the engine is ready for another 550 hours of flying service.

Because so much depends on these tests, nothing is overlooked which might in any way affect the accuracy of the recording instruments. Dust particles, for example, could interfere with the delicate balance of these instruments. So Dust-Stop Air Filters are installed in the air-conditioning system to filter out dust, grit, and lint from the air.

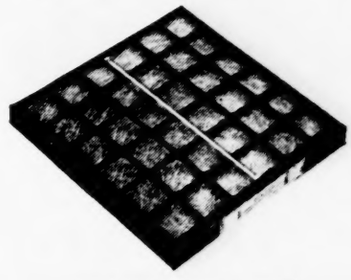
Used in scores of war industries

Dust-Stops are providing clean, filtered air for many commercial and industrial operations. They are used in scores of busy war plants making bomb sights, high-speed motors, precision parts, subassemblies, in paint-spray rooms and other places where manufactured dust must be eliminated or outside air cleaned.

Dust-Stops have a low-cost advantage, too. As original equipment for industrial installations, Dust-Stops cost only about 1¢ per CFM to install. Their replacement cost is less than 1/10th of 1¢ per CFM.

Service of these filters may often be lengthened by vacuum cleaning or gently rapping out excessive surface dirt accumulations. This process may be repeated once or twice to reduce maintenance costs still further.

Ask your regular supplier about Dust-Stops; they are quickly available from local warehouse stock. If he cannot give you complete technical information, write to *Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

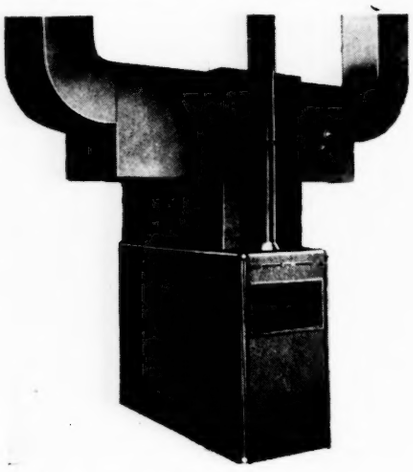


FIBERGLAS*

DUSTOP*

*T. M. Reg. U. S. Pat. Off.

AIR FILTERS

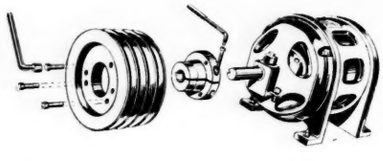


Servel Air Conditioner

NAME — Servel Gas-operated Air Conditioning Unit.
PURPOSE—For heating and cooling houses and small commercial establishments.
FEATURES—Device consists of a gas-fired steam generator operated with an open vent and supplying in the winter steam to a heating coil and humidifier so that warm air can be delivered to the living spaces; in the summer, steam from the generator is diverted to the refrigeration generator where it operates the absorption cycle. Differences in temperature and height of column cause circulation of the refrigerant and solvent in the system, eliminating moving parts. Refrigerating system is sealed in steel with welded joints. Unit is controlled by Selectrol which permits modulating step control of heating and cooling functions. Manual switch on Selectrol automatically changes the flow of steam from the heating coil to the refrigeration generator or vice versa, thus changing from summer to winter or winter to summer operations.
MADE BY—*Servel, Inc., Evansville, Ind.*

Multiple V-Belt Sheaves

NAME—Pyott QD Sheaves for multiple V-belt drives.
PURPOSE — For multiple V-belt drives where quick and easy installation or removal is a factor.
FEATURES—Substantial saving in assembly time, particularly when test runs before shipping are necessary, so that a lowered assembly cost results, is claimed for this device.



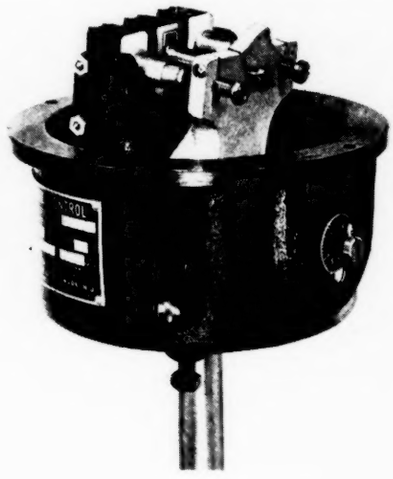
Referring to accompanying illustration, the device is assembled by slipping hub on shaft in line with the keyway, placing key in position, tightening clamping cap screw, tightening key set screw, fixing on tapered hub in line with bolt holes, inserting pull-up bolts and tightening evenly. The tapered friction drive assembly is said to be equivalent to a press fit.
SIZES AND CAPACITIES—Available in a wide range of diameters and number of grooves.
LITERATURE AVAILABLE—18 pp. bulletin, standard size.
MADE BY—*Pyott Foundry & Machine Co., 328 N. Sangamon St., Chicago, Ill.*

Fuel Oil Ration Calculator

NAME—Fuel Oil Ration Calculator.
PURPOSE—To determine easily at any time during the heating season whether more or less fuel oil is being burned than the ration board has allotted.
FEATURES—The calculator consists of two circular discs and is operated by setting the pointer opposite the fuel oil allotment for the year and then reading around the circumference, the allotment by day, week or month. Knowing the amount of fuel burned, it is then apparent whether more or less fuel than allotted is being used.
MADE BY—*Anderson Specialty Co., 215 East 9th St., St. Paul, Minn.*

Burling VD-3 Control

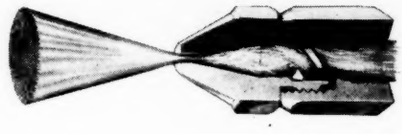
NAME—Model VD-3 Temperature Control Switch.
PURPOSE—For applications in extremely exposed conditions such as on the deck of a ship.
FEATURES—Instrument has three switches which may be (1) normally closed, opens on a rise of temperature, (2) normally open, closes on a rise of temperature, or (3) single pole double throw switches. Has heavy cast iron base and cast cover making it water and vapor tight. Individual adjusting screws with locking screws set temperature at which each switch operates. Main temperature adjustment outside the case is covered by water-tight cap so that the differential between the switches is not affected by temperature changes. Difference between operating temperatures of any two switches may be from 300 to 800F depending upon the sensitivity of the instrument. May be furnished for temperatures from — 100 to 1400F. Model VD-3 will do everything that



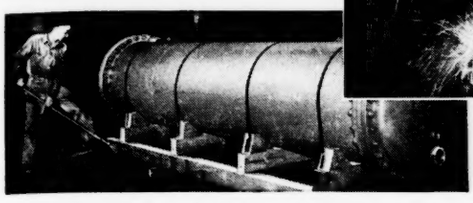
Model VD-II will do plus advantages of another switch to be used as a third control point or high or low temperature alarm.
MADE BY—*Burling Instrument Co., 253 Springfield Ave., Newark, N. J.*

Fulljet Spray Nozzle

NAME—Fulljet spray nozzle, injector type.
PURPOSE—For use where a full cone spray pattern at a highly uniform degree of atomization is required, especially in process applications.
FEATURES—Concentrated narrow-cone said to provide a high degree of impact for any given pressure. Where required an efficient siphoning action may be readily obtained. Water and other liquids of similar viscosity may be handled. Made in brass, steel, Monel metal and stainless steel. Removable internal vanes permit quick, easy replacement.
SIZES AND CAPACITIES—Stocked in a wide range of sizes each having definite performance characteristics. For example, if a process requires delivery of a liquid under 40 lb pressure at a rate of 3 gpm and a spray angle of 30°, a stock size nozzle may be had to perform in exactly this way.
LITERATURE AVAILABLE—Technical reference catalog.
MADE BY—*Spraying Systems Co., Chicago, Ill.*



WORKMEN LONG SKILLED IN THEIR ART...



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This is why America's largest industries — shipbuilders — institutions — Army and Navy look to Adsco for heaters — horizontal or vertical — storage or instantaneous — heat economizers or special equipment to heat or cool water, oil or other liquids. Submit details of your heating or cooling problems or write for bulletin 35-75HV.

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NORTH TONAWANDA, N.Y.

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Are built just right for the job
STORAGE AND INSTANTANEOUS HEATERS
ECONOMIZERS · HEAT OR COOL WATER
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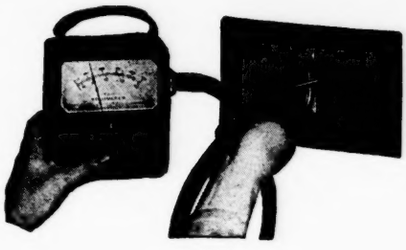

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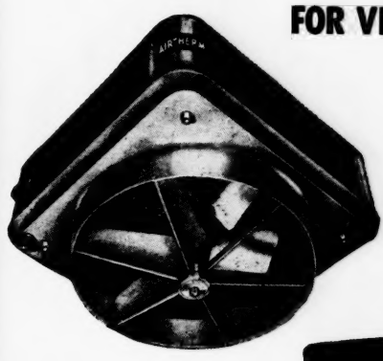
Determination of Air Velocities with the

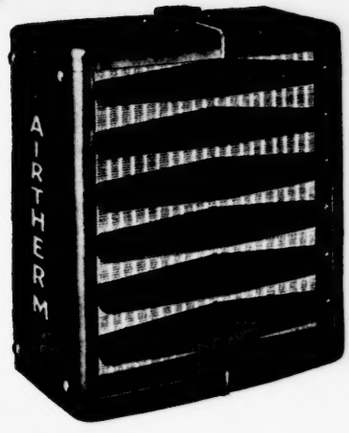
Alnor VELOMETER

No conversion tables, no calculations, no stop-watches are required to determine velocity readings under any situation . . . Alnor Velometer readings are obtained instantly and accurately on the dial calibrated in feet per minute! Notice the typical application illustrated above, showing how readings are obtained on a return grille. The Jet used is specifically for checking suction, exhaust or return readings; other Jets provide for similar readings under all possible conditions—under hoods, in plenum chambers, ducts, etc. New Bulletin No. 2448-E gives full details and lists all Jets and applications. Write for your copy today.

Illinois Testing Laboratories Inc.
143 W. Hubbard St., CHICAGO, ILL.

FOR VERTICAL DELIVERY





FOR HORIZONTAL DELIVERY

AIRTHERM UNIT HEATERS

NOW—MORE THAN EVER—
STURDY CONSTRUCTION COUNTS

To insure maximum heat and usage, all Airtherm Unit Heaters have these features:

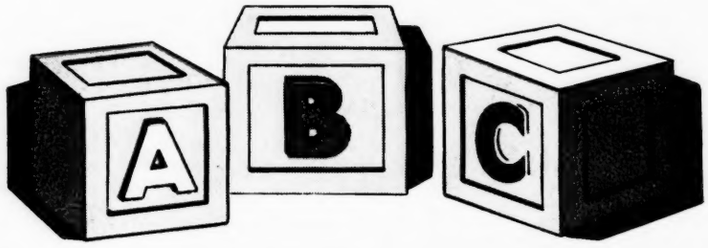
Extra-heavy tube-wall thickness of .065".

Ingot iron tubes.

Lead-alloy coated condensers for greatest possible protection from corrosion.

Condensers guaranteed to withstand steam pressure up to 150 lbs. per sq. in.

AIRTHERM MANUFACTURING COMPANY
722 S. SPRING AVE., ST. LOUIS, MO.

THE  OF FUEL ECONOMY

Saving fuel is as simple as A, B, C. Here are some pointers which will help you and your customers to cooperate with the Government's fuel saving program.
Detroit Lubricator Company is making available to the heating trade this superior equipment to aid in the conservation program. "DL" products are stocked by leading wholesalers, and are distributed nationally by the American Radiator & Standard Sanitary Corp.

Burn Fuel Efficiently

1. Check burner adjustments for greatest efficiency, take draft, CO-2 and stack temperature readings.

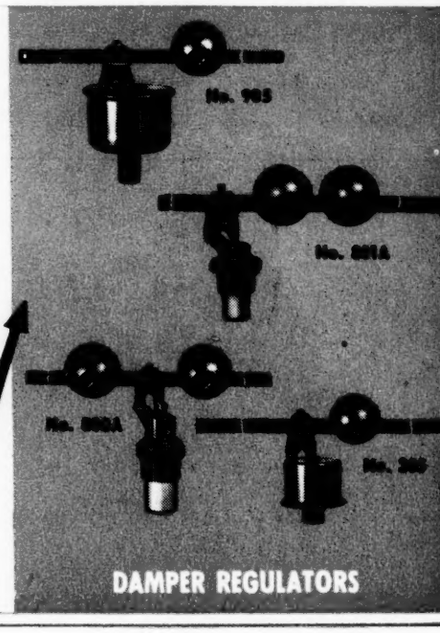
2. Clean oil strainers, nozzles, float valve needles, etc.

3. Check draft adjuster and controls for proper operation.

4. Make sure boiler water is clean and that flues and chimney are free from soot.

5. Inspect chimney and heating unit for air leaks.

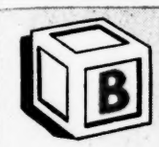
6. Make certain hand fired job is equipped with damper regulator in good working condition, if not install **"DL" DAMPER REGULATORS.**



DETROIT LUBRICATOR

Division of American Radiator and "Standard" Sanitary Corporation

Canadian Representatives—RAILWAY AND ENGINEERING SPECIALTIES LIMITED, MONTREAL, TORONTO, WINNIPEG



Make Sure the Heat Goes Where It's Wanted

1. Make certain air valves and quick vents on steam system vent freely. For fast venting and maximum fuel savings install **ARCO-DETROIT AIR VALVES**

2. Is steam system properly vented and balanced? If difficulty is experienced balancing system, install **ARCO-DETROIT AIR VALVES**

3. Check for sagging or trapped pipes.

4. Insulate boiler, mains, and hot water storage tank.

5. Set balance dampers in ducts properly and check ducts for leaks.

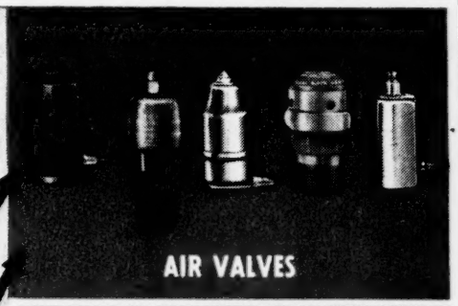
6. Check water supply and keep all radiators vented on hot water system.

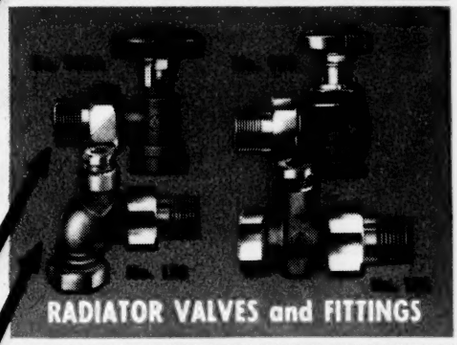
7. Shut off radiators in unused rooms. **"DL" RADIATOR VALVES**

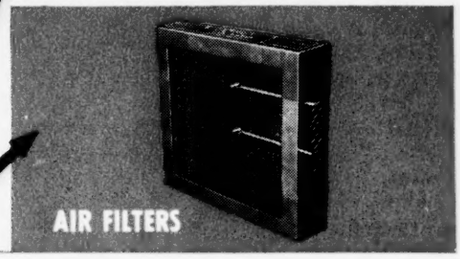
8. Is hot water system properly balanced? If difficulty is experienced balancing system, install **"DL" HOT WATER BALANCING FITTINGS**

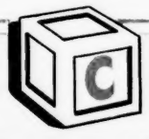
9. Reduce temperature at night or when occupants are absent.

10. Replace dirt-clogged air filters with **"DETROIT" FILTERS**


AIR VALVES


RADIATOR VALVES and FITTINGS


AIR FILTERS



Make Sure the Heat Stays in the House

1. Install adequate insulation.

2. Install storm windows and weatherstripping.

3. Shut off bedroom radiators at night and close bedroom doors.

COMPANY

GENERAL OFFICES:
DETROIT 8, MICHIGAN

"DL" Heating and Refrigeration Controls • Engine Safety Controls • Safety Float Valves and Oil Burner Accessories • Radiator Valves and Balancing Fittings • Arco-Detroit Air and Vent Valves • "Detroit" Expansion Valves and Refrigeration Accessories • Air Filters • Stationary and Locomotive Lubricators

Little Giant Humidifier

NAME — Skilbeck E-120 Little Giant humidifier.

PURPOSE — Humidification of large spaces, such as industrial plants.

FEATURES—Device, 10 in. long and 3 in. in diameter, can be installed in less than an hour. Recommended for use in single units or in groups of two or more. Surplus condensate accumulating in the humidifier can be drained back into the steam riser against pressure, or can be drained into a vacuum return line through a vacuum trap. Adjustment screw at the top of the humidifier permits adjustment to obtain the relative humidity desired. Drain pipe with water seal keeps unit free of accumulation of condensate.

SIZES AND CAPACITIES—Supplies 42 lb of water per hour.

NAME OF DISTRIBUTOR — *Techtmann Industries, Inc., 828 N. Broadway, Milwaukee 2, Wisc.*

Sperry Exactor Control

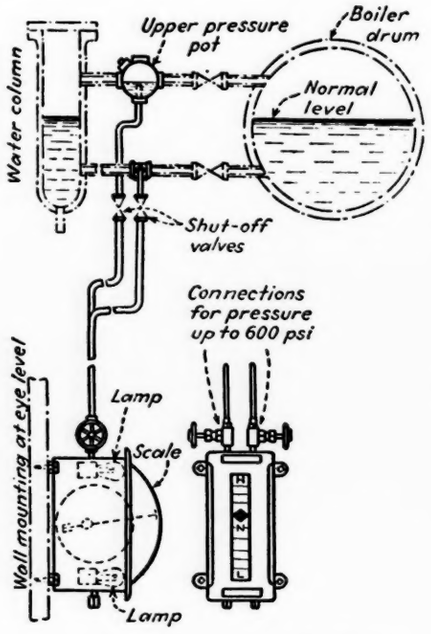
NAME—Sperry Exactor Hydraulic Control.

PURPOSE—For the control of a machine or machines or pieces of equipment from a remote point.

FEATURES—Device consists of a transmitter, which is operated by a manual lever; a receiver, and connecting piping. The motion applied at the transmitter is transmitted hydraulically to the receiver where a mechanical movement is obtainable. The device reproduces exactly the same degree of motion at the receiver that has been applied to the transmitter handle.

LITERATURE AVAILABLE — Bulletin 780.

MADE BY—*Sperry Products, Inc., Hoboken, N. J.*



Remote Water-Level Indicator

NAME—Remote water-level indicator.

PURPOSE—To show level of water in boiler drum.

FEATURES—Instrument operated by difference in pressure in connecting tubes which is merely difference in head between fixed water level in upper pressure pot and varying water level in boiler drum. Pressure differential acts on Neoprene diaphragm. Pin transmits net diaphragm force to spring-metal deflection plate, moving powerful permanent magnet along bronze alloy tubular well containing spiral armature of magnetic material. Thus rotation of armature, and corresponding greatly-magnified motion of pointer, is in direct proportion to movement of diaphragm, actuated by changes in static head.

SIZES AND CAPACITIES — Two models to serve all boiler pressures up to 1500 lb per sq in.

MADE BY—*Yarnall-Waring Company, Philadelphia, Pa.*

Packless Fastener

NAME—Packless Flexible Fastener.

PURPOSE—Has combined function of a supporting strap and a vibration absorber for removable tubing.

FEATURES—Consists of sensitive spring, cone-spiraled and terminating in a clip which snaps on to tube or similar unit to be fastened—right size fastener being chosen to fit O.D. of unit. Fastener is affixed to a supporting surface by means of standard or wood screw fitted through cone. Inasmuch as it flexes in all directions, fastener can be installed in either lateral or vertical position. Its small hose area both facilitates

placement and gives a large working area to the cone. Used with copper tubing, the fastener's free action in all directions prevents crystallizing of the copper such as is induced by rigid metal straps which prevent expansion or contraction (and concentrates all stresses near the couplings). Adapted to application in refrigeration and other industries.

MADE BY—*Packless Metal Products Corporation, New Rochelle, N. Y.*

Automatic Time Control

NAME—Cramer percentage timer.

PURPOSE — For controlling time cycles in such applications as energy input to heaters.

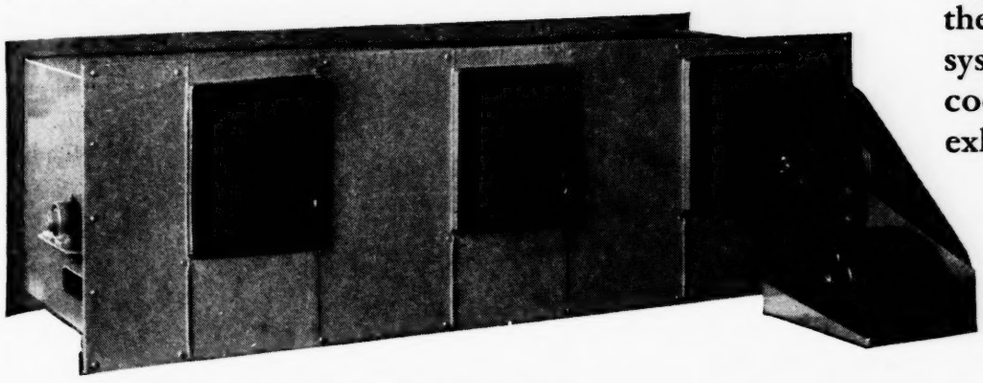
FEATURES — Has self-starting synchronous motor driving a cam-operated switch mechanism through gears. Percentage of operating time is controlled by relationship between a moving cam and a fixed cam on a calibrated dial, and adjustment is accomplished by varying the position of the stationary cam. The timer is enclosed in a dust-tight molded bakelite case, 3¼ in. in diameter and 3 9/16 in. overall length, for flush mounting.

MADE BY—*R. W. Cramer Company, Centerbrook, Conn.*

NIAGARA *Industrial* MOTOR BLOWERS

for VENTILATING, DRYING, EXHAUSTING FUMES *and* LIGHT DUST, HEATING, COOLING, RE-CIRCULATING

3-Fan Unit, Encased, Belt-Driven



Assemblies of 1, 2 and 3 fans; 16 Models, belt driven or direct connected with and without casings. Two series of fans for highest air capacity—up to 4" S. P.

Especially designed to meet the requirements of duct systems in blast heating or cooling or in industrial exhaust systems.

Write for Bulletin 89

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POWERS TEMPERATURE and HUMIDITY CONTROL

When you want accurate and dependable automatic temperature or humidity control for Heating, Ventilating and Air Conditioning Systems or Industrial Processes call in a Powers engineer. With a very complete line of self-operating and compressed air operated controls we are well equipped to fill your requirements.

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DE-STA-CO
Blower Wheel Housings

of Standard Dimensions

Made in sizes to fit 4½, 5, 6, 7½ and 9 inch wheels and in widths to suit single or double inlet wheels . . . also individual parts for your own assembly.

De-Sta-Co housings are engineered for maximum efficiency and quietness in operation . . . neatly finished. Send for "De-Sta-Co Blower Housings" bulletin; gives complete information, including essential dimensions.

DETROIT STAMPING CO.
Established Over 25 Years
375 Midland Ave • Detroit 3, Mich.

REVIEWS

VIBRATION AND ISOLATION

"Elements of Mechanical Vibration," by C. R. Freberg and E. N. Kemler, both on the staff of the School of Mechanical Engineering, Purdue University. Size 5½ x 8½ in., cloth bound, 193 pages. Price, $3.00.

The purpose of this book is to discuss the more elementary phases of vibrations and to reduce them to a form in which they can be applied to practical problems. Particular attention is paid to the many problems which can be solved by using the simpler forms of differential equations, various approximate methods, or the mobility method all of which can be mastered by engineers without training and advance mathematics. With this in mind the text has been kept as simple as possible and numerous examples are included to illustrate the methods, units and applications of formulas.

The book is divided into eight chapters covering Vibrations without Damping; Damped Vibrations; Vibration of Systems with Several Degrees of Freedom; Vibration Isolation and Absorption; Equivalent Systems; The Mobility Method; and Mechanical and Electrical Models of Vibration Systems.

The chapter on Vibration Isolation and Absorption is of particular interest to air conditioning engineers; it includes not only a straightforward and simple discussion of the theory but also descriptions of the commercial types of vibration isolators available on the market and 13 problems at the end of the chapter. The book is recommended particularly for engineers with whom vibration problems are incidental, and for students.

An appendix includes data and types of physical properties and strength of materials. Also included is a bibliography and answers to the problems.

INDUSTRIAL VENTILATION AND HEALTH

"Essentials of Health Maintenance in Industrial Plants," special bulletin No. 213. Published by New York State Department of Labor. Price, 35 cents.

A list of selected references in the field of Industrial Hygiene, dealing with carbon monoxide, dermatitis, dust, gases, silicosis, volatile solvents, and kindred subjects, is given in this 64-page, 6x9 in., paper-covered booklet. Details of medical service in small and large plants, and a complete bibliography, are included.

BRIEF REVIEWS

Boiler Selection—Part II of the Heating, Piping and Air Conditioning Contractors National Association Engineering Standards, devoted to the net square feet radiation loads in 70F., recommended for low pressure heating boilers. The bulletin is of standard size, 3-ring, loose-leaf, punched and includes 12 pages giving the loads depending on the boiler dimensions. Included are charts for making boiler selections for use with stokers and oil burners. Price $1. Part I on Heat Loss Calculations was published last spring and Parts III and IV on pipe sizes and air conditioning are expected to be published before the end of this year. Available from Heating, Piping and Air Conditioning Contractors National Association, Suite 1401, Rockefeller Center, 1250 Sixth Ave., New York 20, N. Y.

Stokers—"Suggested Minimum Firebox Dimensions and Base Heights" for reference in selecting or designing boilers for stoker firing. This 4-page standardized folder represents another step in the stoker industry's program of standardization. Information in the folder represents the results of conferences between engineering and technical representatives of the stoker, boiler, and furnace industry. Available from Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago.

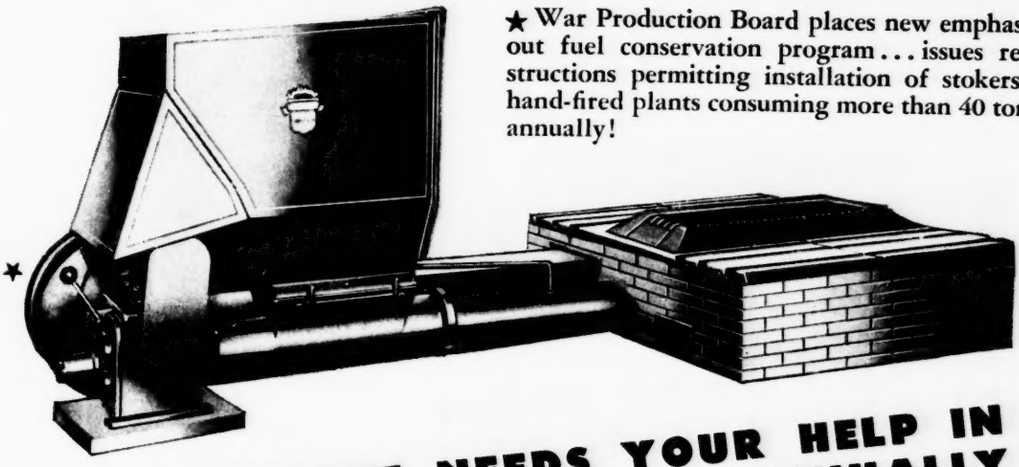
Insulation — Bulletin entitled Industrial Heat and Power Conservation Manual, consisting of practical engineering methods of calculating and preventing fuel losses together with nine typical examples of saving including boiler shells, hot water storage tanks, boiler fittings, dryers, boiler drum heads, feed water heaters, ducts, piping, and flange joints. Each gives the formulas for solving the particular type of problem involved and shows the step by step calculations of a typical example. A heat loss estimate sheet is included for survey use in the plant. Standard size, 20 pages, available on request to the Industrial Mineral Wool Institute, 441 Lexington Ave., New York 17, N. Y.

Stokers—A 4x9 in., 16-page information manual containing membership lists, committees, officers and publications of the Stoker Manufacturers Association as of August 1, 1943. Available from the Association, 307 N. Michigan Ave., Chicago 1, Ill.

Hydraulic Standards—Complete revision of the Test Code Section of the Hydraulic Institute Standards, first published in 1936. Contains specific recommendations for the testing of centrifugal and rotary pumps, both for acceptance tests in the field, and in the plant of the pump manufacturer. The code contains the limiting conditions for all methods of quantitative determination of capacity, head, and power input, whereby the accuracy for an acceptance test can be obtained. Available from Hydraulic Institute, 90 West Street, New York 6, N. Y., at 50c per copy, payable in advance.

MANY *HAND-FIRED* PLANTS NOW ELIGIBLE FOR STOKERS

★ War Production Board places new emphasis on all-out fuel conservation program . . . issues revised instructions permitting installation of stokers in most hand-fired plants consuming more than 40 tons of coal annually!



YOUR GOVERNMENT NEEDS YOUR HELP IN SAVING MILLIONS OF TONS OF COAL ANNUALLY . . .

Do your part by speeding these change-overs with

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COMMERCIAL AND INDUSTRIAL **STOKERS**

FIRST CHOICE OF AMERICA'S FOREMOST HEATING ENGINEERS

Answer the call to service! Cooperate with the government's vital fuel conservation program by speeding conversions of hand-fired and oil-fired plants with Freeman Long-Life Stokers! They have proved their superior efficiency and economy in thousands of installations throughout the world . . . are manufactured by a pioneer leader in the stoker industry, rated AAA 1, established 1864. No other company offers you such an outstanding opportunity for a permanent, profitable stoker business. Write today for complete details on our aggressive promotion program that means essential help for Uncle Sam, sales-winning success for you!

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Freeman Stoker Division, Illinois Iron & Bolt Co.
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CITY STATE

FREEMAN STOKER DIVISION, ILLINOIS IRON & BOLT CO.

GENERAL SALES OFFICES: 918 SOUTH MICHIGAN AVE., CHICAGO 5, ILLINOIS

Young
HEATING AND AIR CONDITIONING for MARINE INSTALLATIONS

YOUNG Heating and Air-Conditioning Units are sea-going veterans with ships of the fleet, cargo craft and the merchant marine. They are engineered for long life, maximum output and sturdy dependability. If you have a space conditioning problem . . . heating or refrigerating . . . consult with YOUNG engineers without delay.

YOUNG RADIATOR COMPANY

Dept. 143-K Racine, Wis., U. S. A.

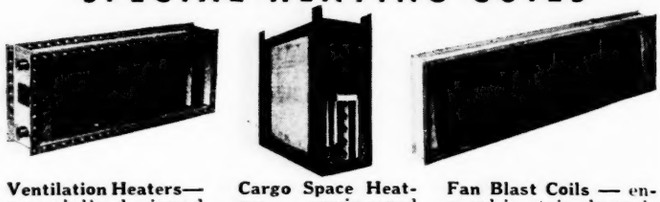
YOUNG STANDARD COILS

Water Coils — continuous tube type for cooling with water or brine.

Heating Coils — standard or steam distributing tube types.

Evaporator Coils — continuous tube type with patented refrigerant distributor.

SPECIAL HEATING COILS

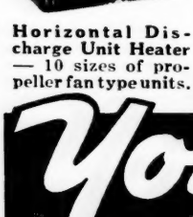


Ventilation Heaters— especially designed for marine heating and ventilating.

Cargo Space Heaters — engineered specifically for dehumidifying and heating cargo holds.

Fan Blast Coils — encased in stair channels for added rigidity and strength.

STANDARD HEATING UNITS



Horizontal Discharge Unit Heater — 10 sizes of propeller fan type units.

These units are available with copper coil construction for marine installations, military contracts and essential industries where permitted.

Streamaire Convectors—4 cabinet types for steam or hot water systems.

Buy Bonds — Produce More Salvage Scrap—Win the War

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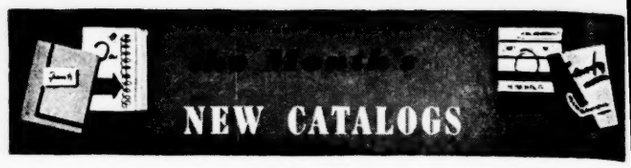
PRODUCT OF Young ENGINEERING AND MANUFACTURING SERVICE SPECIALIZING IN HEAT TRANSFER PRODUCTS

HEAT TRANSFER PRODUCTS

OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • INTERCOOLERS • HEAT EXCHANGERS • ENGINE JACKET WATER COOLERS • UNIT HEATERS • CONVECTORS • CONDENSORS • EVAPORATORS • AIR CONDITIONING UNITS • HEATING COILS • COOLING COILS



VIBRATION CONTROL

The Korfund Company, Inc., Long Island City 1, N. Y.

Catalog G-100, a 24-page, standard size, 3-color guide book on the subject and theory of vibration control for stationary and marine service. Bulletin is primarily devoted to theory application and illustrations including main propulsion engine installations. Provides a complete guide for the solution of vibration problems which arise in office buildings, industrial plants, and on board ship, due to the operation of machinery, refrigerating and ventilating equipment, and other similar apparatus. A feature of the guide is a simple and well-done index showing the different types of vibration isolators available from the company together with a drawing showing how they work, the direction of thrust, the load per unit which can be carried, brief remarks regarding each type, and page where detailed information is given.

WATER LEVEL INDICATOR

Yarnall-Waring Company, Chestnut Hill, Philadelphia 18, Pa.

An 8-page, standard-size folder in color covering the Yarway remote water level indicator. Illustrated by numerous photos and diagrams to show how it works, how it is installed and how it operates.

APARTMENT HEATING

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

A 16-page bulletin entitled "Minneapolis-Honeywell Announces Personalized Heating Control for Apartments." By personalized control is meant the selection of his own apartment temperature by each individual tenant. Shown are the advantages of such a control to owners, operators, and tenants. The latter part of the book is devoted to showing how personalized control can be accomplished either by individual apartment control, by single control of the individual apartment, or by individual room control. Includes illustrations and designations of different pieces of company's equipment used to make up any one type of system. Information is also given on the boiler control systems for use in connection with personalized apartment heating.

VALVES

Darling Valve and Mfg. Co.
Williamsport, Pa.

A 324-page industrial valve catalog, 7¾ by 10¾ inches, bound in durable blue cover, and containing over 600 photographs, sectional views, designs, detailed drawings and other illustrations.

STEAM HEATING

Gorton Heating Corp., Cranford, N. J.

Bulletin No. 113, 4-pages, standard size, giving information on the company's line of steam heating air eliminators and equalizing valves.

INSULATION

"Asbestos"
Inquirer Building, Philadelphia, Pa.

A new 5 x 7½ in., 16-page, Factbook giving complete information about asbestos is available. The origin, sources, uses, analyses, and qualities of the mineral are included.

CONDUITS

The Ric-wiL Company, Cleveland, O.

A 4-page folder in color briefly describing and illustrating all of the company's numerous types of insulated pipe units, conduits and accessories.

ENGINEERING

Lockwood Greene Engineers, Inc.,
10 Rockefeller Paza, New York 20, N. Y.

A four-page brochure illustrating a Navy materials testing laboratory and an important project designed by this firm and containing many unusual features. The folder is entitled "Where the Password is 'Perfect'."

FURNACES

L. J. Mueller Furnace Company, Milwaukee, Wisc.

Portfolio entitled "Mueller's Contribution to the War Effort" and showing, by illustrations, including full page four-color photographs, the work Mueller is doing in ordnance manufacturing.

CONTROLS

The Bristol Company
Waterbury, Conn.

Bulletin No. 513 standard size, 4-pages, describes the company's Metavane System of pneumatic telemetering, or the distance measurement of temperature, flow pressure, and liquid level. Recording, indicating, and controlling principles are explained.

GLASS BLOCKS

Owens-Illinois Glass Company, Toledo, Ohio

Methods for replacing worn-out windows with Insulux glass block are described in a new standard size, 24-page bulletin which includes photographs and diagrams of typical installations, technical data and construction details.

HUMIDIFIERS

Armstrong Machine Works, Three Rivers, Mich.

A standard size, 8-page bulletin in color, describing the application of humidification in a wide variety of industries and the benefits it provides. Among the industries mentioned are textile, woodworking, chemical, food, explosives, printing, paper, leather, and rubber. Data are also included on the use of humidification for the control of dust, lint, and static electricity, and for increasing human comfort and efficiency.

ELECTRIC EQUIPMENT MAINTENANCE

Ideal Commutator Dresser Co., Sycamore, Ill.

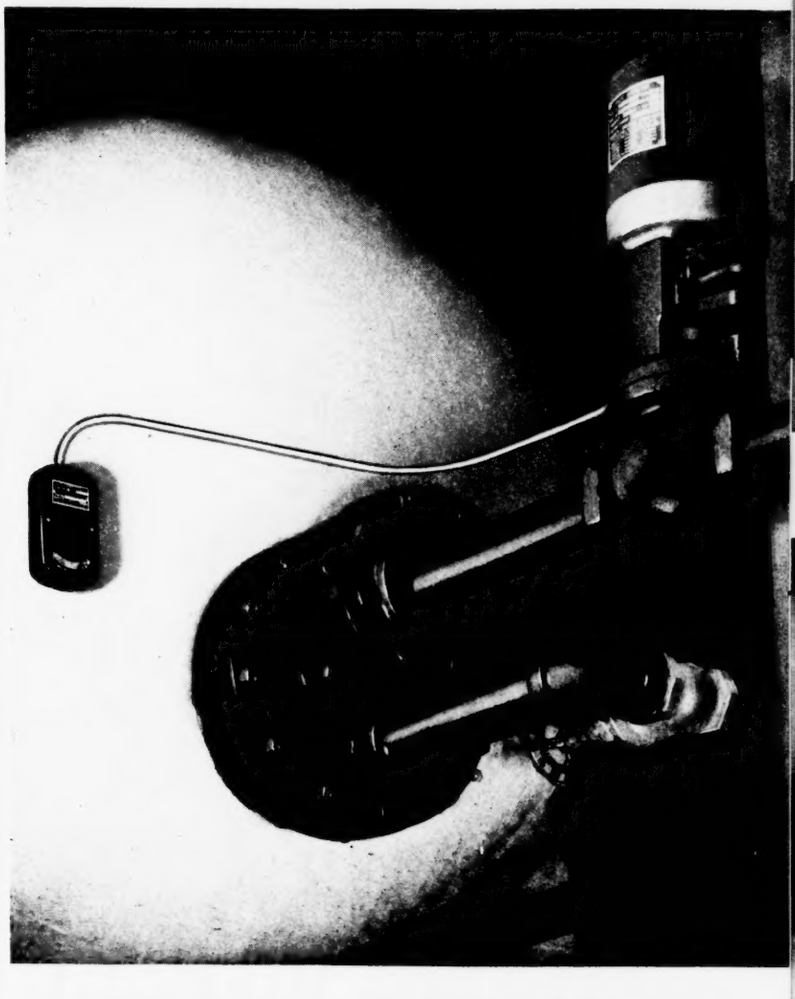
A standard size, 88-page handbook No. 143, profusely illustrated and covering the company's line of maintenance and other industrial equipment including commutator resurfacers, coil winding equipment, wire insulation strippers, industrial cleaners, speed transmissions and tools. Interspersed with catalog material is much valuable information on maintenance.

BARBER-COLMAN

GRILLES & REGISTERS
AIR DIFFUSERS

MAXIMUM SERVICE Controls by BARBER-COLMAN COMPANY MINIMUM MAINTENANCE

AUTOMATIC CONTROLS



AUTOMATIC CONTROLS FOR HOT WATER STORAGE

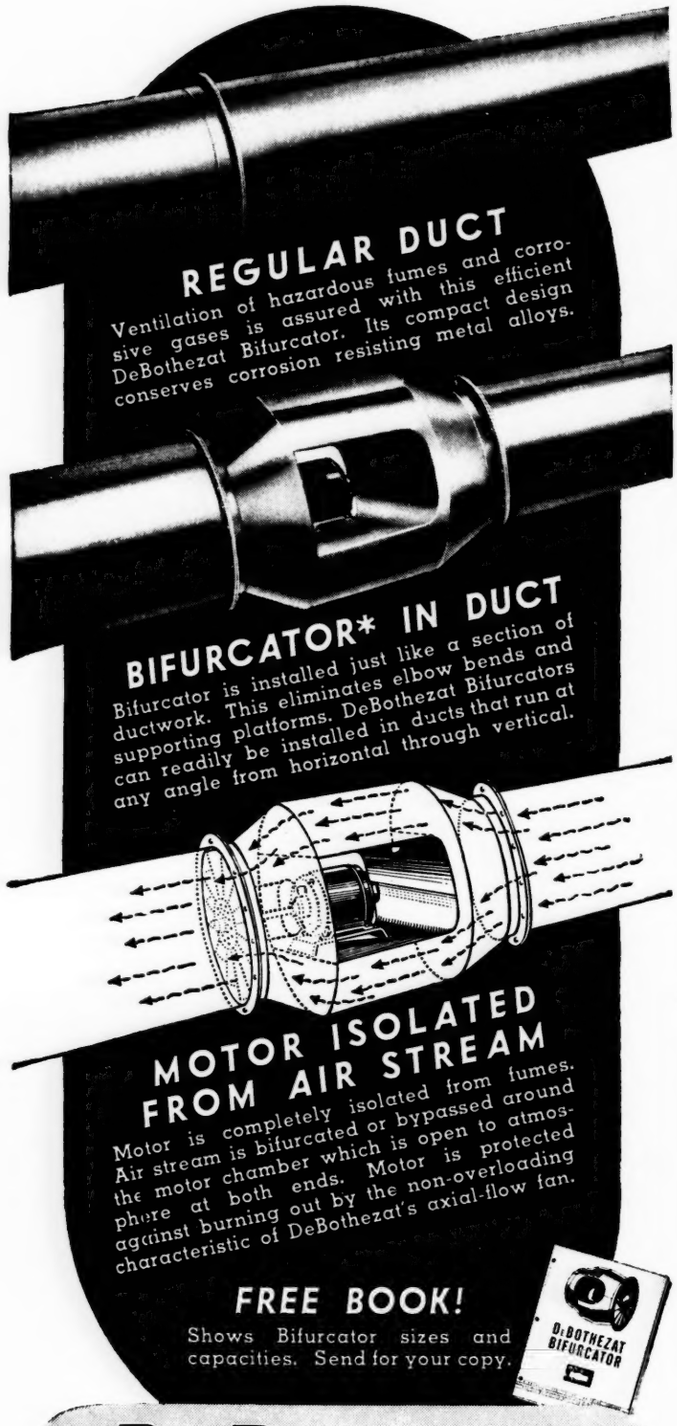
★ The storage of an adequate supply of hot water for washing and other purposes presents a problem of temperature control as well as of proper size and distribution of tanks. Actually, a control installation on each of a number of tanks will usually reduce the operating cost over the installation of a control on the central supply alone. Barber-Colman control equipment has demonstrated its ability to provide accurate maintenance of water temperature in storage tanks.

WATER KEPT HOT AT MINIMUM EXPENSE

★ With a simple BARBER-COLMAN CONTROL, consisting of a Thermostat in the tank and a Motor-Operated Valve on a steam supply line, the water in each tank is automatically maintained at the desired temperature. Heat losses from water supply lines are reduced to a minimum and the amount of steam used is also kept at a minimum by the automatically-operated valve. Once the thermostat is set, practically no attention is required for either adjustment or maintenance. BARBER-COLMAN equipment is quality-built throughout to assure a long life of dependable operation.

BARBER-COLMAN COMPANY 1224 ROCK STREET ROCKFORD, ILLINOIS

This
DIFFERENT TYPE VENTILATING UNIT*
installs in the Duct


REGULAR DUCT
Ventilation of hazardous fumes and corrosive gases is assured with this efficient DeBothezat Bifurcator. Its compact design conserves corrosion resisting metal alloys.
BIFURCATOR* IN DUCT
Bifurcator is installed just like a section of ductwork. This eliminates elbow bends and supporting platforms. DeBothezat Bifurcators can readily be installed in ducts that run at any angle from horizontal through vertical.
MOTOR ISOLATED FROM AIR STREAM
Motor is completely isolated from fumes. Air stream is bifurcated or bypassed around the motor chamber which is open to atmosphere at both ends. Motor is protected against burning out by the non-overloading characteristic of DeBothezat's axial-flow fan.
FREE BOOK!
Shows Bifurcator sizes and capacities. Send for your copy.
DeBOTHEZAT BIFURCATOR

DeBothezat Bifurcators*

DE BOTHEZAT DIVISION of AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS

WITH THE MANUFACTURERS

PENN ELECTRIC SWITCH CO.

Goshen, Indiana, has appointed Judson P. Bowen as manager of its Atlanta branch located at 36 Fifth St., N.W. He succeeds N. E. Jennison, former manager, who has been shifted to the factory in Goshen, Ind., to assume new duties in the Company's research laboratory. Mr. Bowen was formerly with American Radiator, American Blower Co., Georgia Power Co., Kelvinator, Westinghouse, and Larkin Coil Co.

RALPH PENN

has been appointed director of engineering of Penn Electric Switch Co., Goshen, Ind. This position is in addition to that of treasurer of the company. Since the founding of the company, 25 years ago, Mr. Penn has devoted much of his time to the engineering and development phases of the business. For the past two years, he was directly in charge of the company's special development department in St. Louis.

Ralph Penn

Burton Shaw, research chief, will continue to function as in the past.

P. C. SHARP

export manager of the Brown Instrument division of the Minneapolis-Honeywell Regulator Company, has been appointed acting manager of the Washington, D. C., office of the company's New York zone. He replaces M. E. Van Vliet, who resigned to enter government service. Mr. Sharp will continue as export manager but he will make his headquarters in Washington, since much of the company's export business involves lend-lease or other government agencies.

H. D. CONKEY & CO.

Mendota, Illinois, in order to be prepared for quick conversion to post-war production, is translating into specific action the post-war plan of its heating equipment divisions—Conco Engineering Works and Field Control Division. Considerable new laboratory space for the development and testing of improved heating equipment products has been added. E. A. Field, Jr., inventor and chief engineer for Field draft controls, has been appointed chief developmental engineer for the new line of Field and Conco heating and conditioning equipment. Walter Knox, research engineer formerly with Kopper's Company, has been added to the company's staff to share in the responsibility for the design and testing of Conco's post-war heating and equipment line.

Walter Knox

E. A. Field, Jr.

TUTHILL PUMP COMPANY

Chicago, has appointed H. T. Kessler, formerly vice-president, as executive vice-president and general manager. W. D. Caldwell, controller, becomes assistant treasurer, retaining the duties of controller; and Jess Tharp has been appointed works manager.

GAR WOOD INDUSTRIES, INC.

Detroit, has appointed George D. Shaeffer as chief engineer of Gar Wood engineering departments. Mr. Shaeffer, previous to his present assignment, was chief engineer of the road machinery division.

JOSEPH E. WILHELM

chief engineer, Avery Engineering Company has been elected chairman of the Cleveland section of the American Society of Refrigerating Engineers for the 1943-44 season.

BROWN INSTRUMENT COMPANY

Division Minneapolis-Honeywell Regulator Company has made some shifts in executive personnel to expedite post-war planning. K. R. Knoblauch, assistant general sales manager, will devote his time to directing market extension and sales promotion. W. H. Steinkamp will become assistant general sales manager and take over Mr. Knoblauch's former activities in directing field personnel. Mr. Steinkamp has been in charge of the Pittsburgh district office and will be replaced by R. A. Weikel as acting manager of the Pittsburgh office.

H. A. THRUSH & CO.

Peru, Ind., has transferred Harry E. Thompson from Hartford, Conn., to Boston as New England district manager. Mr. Thompson has had many years' experience with Thrush in engineering and sales at the factory, and in its field organization in the Philadelphia and Hartford areas.

NAROWETZ HEATING & VENTILATING COMPANY

1711-1717 Maypole Avenue, Chicago 12, Ill., has remodeled the residence at 1722 Washington Blvd., the three floors of which will now house the firm's offices.

A R M Y – N A V Y

A W A R D S

Buffalo Pumps, Incorporated, Buffalo, N. Y.
(Second Renewal)

Jenkins Bros., Bridgeport, Conn.
(Second Renewal)

The Formica Insulation Company, Cincinnati, Ohio.
(Renewal)

Are You Working on Post-War Plans?

When the war is over will your organization — your product — your service — readily adapt itself to post-war conditions? Have wartime developments revealed the extent to which new designs and methods must be considered?

We at White-Rodgers cannot answer these questions for you. But, if the control of temperature and pressure is essential to the successful application of your product or service, we will be glad to tell you about the White-Rodgers Hydraulic-Action principle of temperature control and the advantages it offers.

To assist you in setting up your post-war plans we have prepared a "Post-War Planning Checklist." We will be glad to send you a copy upon request.

HYDRAULIC ACTION CONTROL

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